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## CONTENTS

# JOURNAL
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# A Report on Wild Life Surveys in South and West India

## November-December 1966

BY


J. JUAN SPILLETT




## INTRODUCTION

This is a continuation of the ' Report on Wild Life Surveys in North India and Southern Nepal, January-June 1966', [*J. Bombay. nat. Hist. Soc.* **63** (3) (December 1966)]. As before, these surveys in the States of Andhra Pradesh, Mysore, Madras and Gujarat were officially sponsored by the World Wildlife Fund (Morges, Switzerland), assisted by the Johns Hopkins University Center for Medical Research and Training, approved by the Government of India and financed by the Foundation Volkart Brothers of Switzerland.

Mr. E. P. Gee made all the necessary arrangements with the Government of India and with the State Forest Departments concerned, supervised the whole project, and collected and edited the reports of each

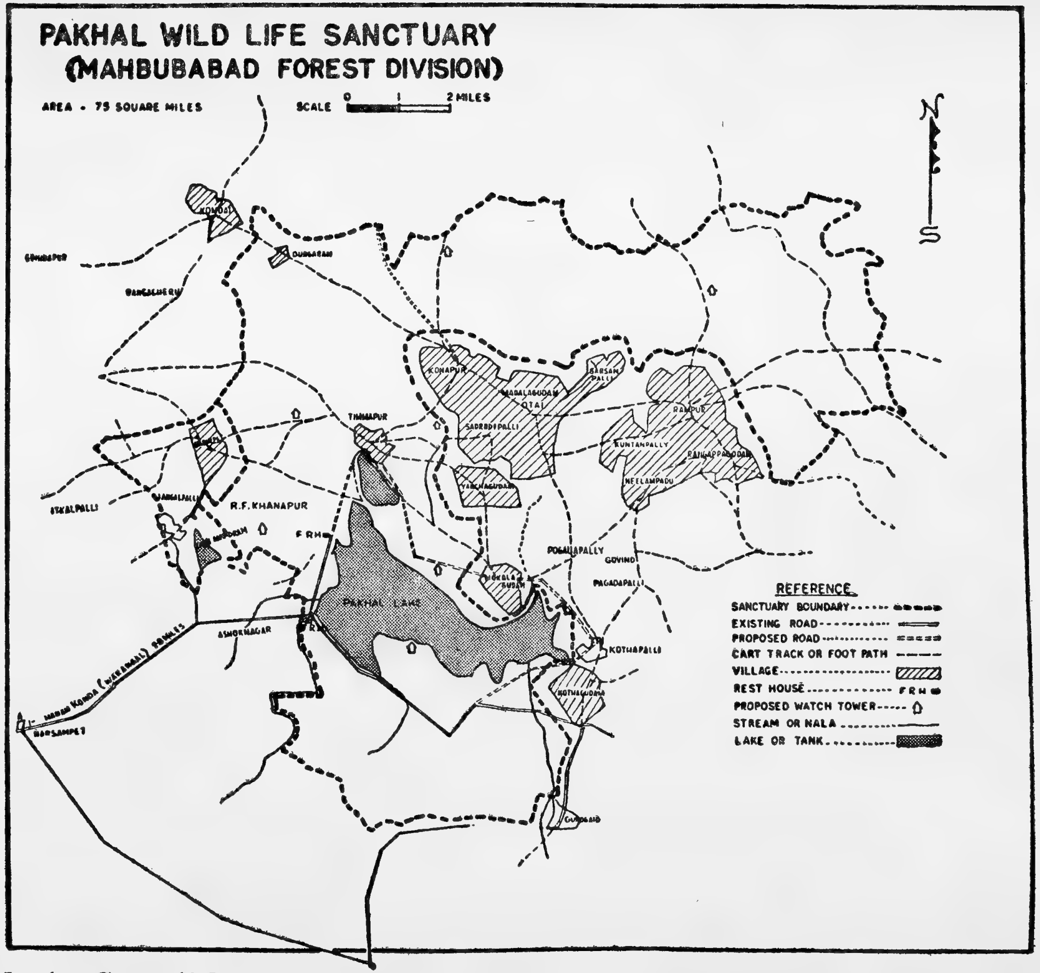
[1] The reports on sanctuaries in Mysore and Madras States will be published in subsequent issues of Vol. 65—Eds.

State—incorporating the suggestions received from the State Forest and Wild Life Officers concerned. I particularly want to thank him for his assistance and advice.

It was intended to include Kerala State, particularly the Periyar Wild Life Sanctuary, in the surveys. But a reply could not be obtained from that Forest Department until it was too late and the whole programme had been finalised. It is to be hoped that at some future date the valuable wild life resources of Kerala can be included in a similar survey.

My thanks are again extended to all concerned for their assistance, co-operation and kindness so willingly given to me throughout the surveys. Without this co-operation the surveys could not have been undertaken.

J. JUAN SPILLETT




Map 1. General Map of the newly proposed Pakhal Wild Life Sanctuary, Andhra Pradesh. The boundary line, which is to be demarcated, existing roads and roads to be constructed prior to 1971 are depicted.

# Wild Life Sanctuaries in Andhra Pradesh[1]

BY

J. JUAN SPILLETT

*(With a plate and two maps)*



TABLE



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[1] This survey was officially sponsored by the World Wildlife Fund, Morges, Switzerland. The project was also assisted by The Johns Hopkins University and its Center for Medical Research and Training, Calcutta, India, and Baltimore, Maryland (U.S.A.). Mr. E. P. Gee, member of the Indian Board for Wild Life, made the necessary arrangements with the Government of India and the Forest Department of Andhra Pradesh, both of which extended their fullest co-operation.

## I. Introduction

Mr. Mazharuddin Ahmed (Deputy Chief Conservator of Forests) met me on my arrival in Hyderabad on November 17, 1966, and kindly accompanied and assisted me throughout my 6-day tour in Andhra Pradesh. We travelled by car to Hanamkonda, 90 miles north-east of Hyderabad, and there met Mr. M. S. Khan (Warangal Circle Conservator of Forests) and other Government and Forest Department officers for that area. We discussed at length the wild life of Andhra Pradesh, the problems confronting these valuable resources and the possibility, through intensive management, of the State's wild life becoming a tourist attraction and a major source of revenue.

## II. THE PAKHAL WILD LIFE SANCTUARY

### Introduction

Pakhal Lake is situated in a beautiful forest setting 28 miles east of Hanamkonda (Warangal) in the Narsampet Taluk of Warangal District. An area of almost 350 square miles surrounding the lake was declared a wild life sanctuary in 1953. However, apart from the prohibition of legal shooting, this area has been a sanctuary in name only. Forest produce of all types has been extensively exploited and domestic livestock grazing has been permitted throughout most of the area. Much of the sanctuary has been severely overgrazed. In addition, encroachment or settlement and cultivation by villagers inside the sanctuary has continued almost completely unabated. To remedy this situation, the Forest Department presently proposes that a 75-square-mile area, including the 8·07 square-mile Pakhal Lake and the adjacent forest areas, be constituted and preserved as a true wild life sanctuary. In short, the Forest Department now proposes to maintain this unit as a real ' Sanctum Sanctorum'.

Pakhal Lake was formed by the construction of an earthen dam during the Kakatiya Dynasty in the early 1600's. The dam was renovated by the Public Works Department (P.W.D.) in 1918 and the lake presently provides water for the irrigation of almost 9000 acres of fertile agricultural land to the south-west. The forest areas surrounding the lake served as a hunting reserve for the Nizam when Hyderabad was a princely state. The area was then renowned for its numerous tigers, as well as for large mammals such as chital, sambar, blackbuck, nilgai, four-horned antelope and chinkara. In 1948, shortly after Independence, this area came under the jurisdiction of the Government of India and the Forest Department.

The preservation and management of Pakhal as an inviolate wild life sanctuary will fulfill a multi-purpose objective. First, it will help to

preserve a part of India's unique and once vast, but now fast disappearing, wild life heritage. In turn, through proper management, the sanctuary should shortly become a notable tourist attraction and a valuable economic asset both to the State and to the Nation. Also of importance, the catchment areas surrounding the lake will now be protected, thus helping to prevent erosion of the forest slopes and ensuring a stable water supply for the agricultural lands of Warangal District.

All forest exploitation, including the grazing of domestic livestock, will be excluded from the proposed 75-square-mile 'L-shaped' sanctuary as of April 1967 (Map 1). The sanctuary will also be clearly demarcated from surrounding areas by clear-felling and maintaining an approximately 50-foot-wide boundary line along the perimeter. A single road enters the sanctuary near the forest rest house and bisects it south of the lake. Entrance into and activities within the sanctuary should therefore be quite easily controlled by a relatively small Forest Department staff.

Three small forest villages inside of the proposed sanctuary (Durgarum, Dabirpet, and Timmapur), with a total population of less than 300 people, will be resettled elsewhere on Forest Department lands. A number of villages north and east of Pakhal Lake were too large to permit such action. Therefore, they will be excluded from the sanctuary by the boundary line. Initially the exclusion from the sanctuary of almost 4000 head of livestock from these villages may present some difficulties. However, there are sufficient grazing lands available for these animals either in the immediate vicinity of the villages or in Forest Department lands south and east of the sanctuary. There is no justifiable reason why domestic livestock should not be completely and permanently excluded from the entire sanctuary. Such problems should be met and permanently settled as soon as possible.

## Ecology

The Pakhal Wild Life Sanctuary is located at an elevation of 850 feet above sea-level. There are no perennial streams in the area. However, the lake, which attains a maximum depth of 18 feet, is fed by a number of ephemeral streams. Rainfall is monsoonal (June-September) and the average annual precipitation is about 40 inches (1000 mm.). The maximum temperature during summer (March-June) is 114·0° F. (45·5° C.) and the minimum during winter (November-February) is 59·20 F. (15·1° C.).

### Flora

The forests in the sanctuary area, according to Champion's classification, are of the southern dry mixed deciduous type and their density

varies from 5 to 7. The forest height is generally from 30 to 40 feet, but along the ravines or *nullahs* the trees often attain a height of about 60 feet.

The predominant species of trees are: *maddi* (*Terminalia tomentosa*), *tirman* (*Anogeissus latifolia*) and *nalla kodsha* (*Cleistanthus collinus*). Also common are: *anduk* (*Boswellia serrata*), *billu* (*Chloroxylon swietenia*), *tooki* (*Diospyros choloroxylon*), *sundra* (*Acacia sundra*), *tapsi* (*Sterculia urens*) and *kondagogu* (*Cochlospermum religiosum*). Teak (*Tectona grandis*) is common in some parts of the sanctuary and numerous other tree species are relatively common in others. *Theega moduga* (*Butea superba*) and *parki* (*Acacia caesia*) are the most common climbers. There are very few shrubs or bushes in the area.

**Fauna**

Numerous species of birds were observed during my brief visit. Among the more obvious noted were: peafowl, grey junglefowl, both grey and painted partridge, ring doves, green pigeon, mynas, babblers, egrets, grey hornbills, roseringed and blossomheaded parakeets, cormorants, herons, Indian rollers and woodpeckers, as well as many smaller species. Other animals observed or reported to inhabit the sanctuary and a relative index as to their abundance is given in Table 1. Gaur or Indian 'bison' (*Bos gaurus*) are not found in the sanctuary, but are common in the forests of the Salvai and Pasra ranges approximately 5 miles to the north-west. Among the fish that inhabit Pakhal Lake are 'katla' (*Catla catla*), 'rohu' (*Labeo rohita*) and 'marul' (*Ophicephalus striatus*).

## Visitor Facilities and Forest Department Proposals

The nearest commercial airport to the Pakhal Wild Life Sanctuary is at Hyderabad (Begumpet), 118 miles to the south-west. Flights from other major cities in India arrive there daily. There is also an airstrip at Mannoor, about 30 miles from the sanctuary near Warangal. Private or chartered planes may land there by special permission. Railway stations are located at Kazipet (Warangal), which adjoins Hanamkonda, and at Nekkonda, which is 20 miles from Pakhal. Public transport can be taken from either of these places to the sanctuary. The first 21 miles of road from Hanamkonda to Pakhal is blacktopped and the last 7 miles is a good metalled road. Although the sanctuary is readily accessible by car throughout the year, the best season for visitors is from October until March.

There are presently less than 10 miles of forest roads within the proposed sanctuary. However, the Forest Department proposes to build a 'ringroad' around the lake, as well as 'feeder' roads to

Spillett : Wild Life Surveys

*Above :* Pakhal Lake as seen from the Sarovihar Rest House ; *Below :* A male four-horned antelope.

(*Photos : Author*)

six watchtowers in the interior of the sanctuary, by the end of 1971. In addition to the road that now bisects the sanctuary south of the lake, the ringroad will entail the construction of another 15 miles of road. The feeder roads leading to the watchtowers will average about 2 miles each. Artificial salt licks also will be constructed in the vicinity of the watchtowers. These improvements should permit visitors to view wild life, particularly during the summer when the animals are concentrated around Pakhal Lake which is the only available source of water during the dry season. The Forest Department also plans to provide a jeep and to have a riding elephant stationed at the forest rest house for the use of visitors.

Pakhal Lake has the potential of becoming a noted fishing area, as well as a recreational site for boating, camping, and picnicking. The Forest Department presently has a row-boat stationed at the lake for the use of visitors and plans to have a motor-boat available in the near future. Some forest areas adjoining the lake, particularly the area just below the dam, are excellent picnic sites and their development as such should be considered.

There are two rest houses within the sanctuary. Both have magnificent views of Pakhal Lake and are located along its shores. One (Sarovihar) is located across the dam on the western shore. It has four suites and is presently under the control of the Tourist Department (Directorate of Publicity and Information), but should come under the jurisdiction of the Forest Department during the early part of 1967. A cook and modern conveniences, such as electricity provided by a small generator, are available here. The other rest house is located about a half-mile south of Sarovihar, a short distance from where the road from Hanamkonda enters the sanctuary. This Forest Department Rest House has three suites, but presently is not provided with modern conveniences. The Forest Department proposes to renovate the building and to provide the services of both a cook and an electric generator prior to 1968. Information concerning the sanctuary or reservations for accommodations can be obtained from either the Divisional Forest Officer, Mahbubabad, Warangal District, or from the Chief Conservator of Forests in Hyderabad.

The most important of the Forest Department's proposals are the strict prohibition of domestic livestock grazing and the discontinuation of forest operations, including the collection of minor forest produce, inside the sanctuary. Plans for clearly demarcating the sanctuary and providing amenities for visitors, i.e., accommodation, roads, transportation, and so forth, are also noteworthy. Among other improvements envisioned are: the provision of six watch-towers near artificial salt licks, road blocks to control movements inside the sanctuary, the construction of quarters for the sanctuary staff, the provision of a library on wild life

TABLE 1

NAMES OF SOME ANIMALS INHABITING THE PAKHAL WILD LIFE SANCTUARY, ANDHRA PRADESH, AND A RELATIVE INDEX OF THEIR ABUNDANCE

| English | Local | Scientific | Abundance |
|---|---|---|---|
| Tiger | Bagh, Sher | *Panthera tigris* | rare |
| Leopard or Panther | Tendwa, Chita | *Panthera pardus* | rare |
| Jungle Cat | Khatas, Jungli billi | *Felis chaus* | common |
| Striped Hyena | Hundar, Lakkar | *Hyaena hyaena* | rare |
| Wild Dog or Dhole | Dhole, Jangli kutta | *Cuon alpinus* | rare |
| Jackal | Gidhar, Kola | *Canis aureus* | common |
| Indian Fox | Lomri, Lom, Lotri | *Vulpes bengalensis* | frequent |
| Common Mongoose | Mangus, Newal | *Herpestes edwardsi* | common |
| Sloth Bear | Bhalu, Rinch, Reech | *Melursus ursinus* | rare |
| Wild Boar | Suar, Barba | *Sus scrofa* | common |
| Sambar | Sambar, Samar | *Cervus unicolor* | common |
| Chital or Spotted Deer | Chital, Chitra | *Axis axis* | common |
| Barking Deer or Indian Muntjac | Kakar | *Muntiacus muntjak* | frequent |
| Nilgai or Bluebull | Nil, Nilagai | *Boselaphus tragocamelus* | common |
| Chinkara or Indian Gazelle | Chinkara, Kalpunch | *Gazella gazella* | rare |
| Blackbuck or Indian Antelope | Harna, Harni, Kalwit | *Antilope cervicapra* | rare |
| Four-horned Antelope or Chousingha | Chowsingha, Chowka Doda | *Tetracerus quadricornis* | rare |
| Common Indian Porcupine | Sayal, Sahi | *Hystrix indica* | common |
| Indian Hare | Khargosh | *Lepus nigricollis* | common |
| Common Langur or Hanuman Monkey | Langur, Hanuman | *Presbytis entellus* | common |
| Rhesus Macaque | Bandar | *Macaca mulatta* | frequent |
| Indian Python | | *Python molurus* | rare |
| Cobra | Nag | *Naja naja* | rare |
| Russel's Viper | Sus-Karna | *Vipera russelli* | rare |
| Banded Krait | | *Bungarus fasciatus* | rare |
| Rat Snake | Dhaman | *Ptyas mucosus* | common |
| Mugger | Magger Mach | *Crocodilus palustris* | frequent |

in one of the rest houses, and the purchase of equipment which will better enable members of the sanctuary staff to perform their duties, i.e., a typewriter, binoculars, bicycles for the Assistant Game Wardens and Game Trackers, etc. A detailed working plan and budget for the implementation of the proposals and for the maintenance of the sanctuary staff has already been submitted to the State Government by the Forest Department.

## Discussion

The scenic beauty of Pakhal Lake in its sylvan setting is sufficient grounds for setting this area apart as a park or recreational site. The wild life may be classified as an added attraction. Although relatively few wild mammals were observed during my visit, their numbers should soon increase if the proposed measures to prohibit all livestock grazing and forest exploitation inside the sanctuary are fully implemented. The possibilities are very good that within a few years visitors may readily observe numerous animals such as chital, nilgai, sambar, and so on.

It is to be hoped that in the implementation of the measures proposed by the Forest Department the sanctuary will be retained in as natural a state as possible ; that an excessive number of roads will not be constructed ; that the areas surrounding the rest houses or the quarters of the administrative staff will not be permitted to become virtual villages within the sanctuary ; and that the recommendations of the Indian Board for Wild Life (Gee 1962) and other international organizations concerned with conservation will be carefully considered and as closely adhered to as possible in the development of this outstanding area.

Administrative personnel for the Pakhal Wild Life Sanctuary should be carefully chosen. Men with a genuine interest in wild life conservation should be given preference. If at all possible, the staff members should also become acquainted with some of the basic concepts of wild life management. Once the basic amenities for visitors are available at the sanctuary, a publicity programme should be initiated to help as many people as possible become aware of what this area has to offer. A continued programme of conservation education should also be maintained. Competent biologists should be encouraged to conduct scientific studies of the sanctuary's wild life. Check-lists of the flora and fauna should also be compiled, both for the information of visitors and the Forest Department staff. A visitor's book should be maintained so that all who enter the sanctuary may record their observations concerning the sanctuary's wild life.

A wild life sanctuary is an investment in the future. Like any sound business it requires a capital outlay, upkeep, and proper management before a substantial return may be realized. In my opinion, the present proposals of the Forest Department are a major step in the right direction.

## III. THE ETURNAGARAM WILD LIFE SANCTUARY

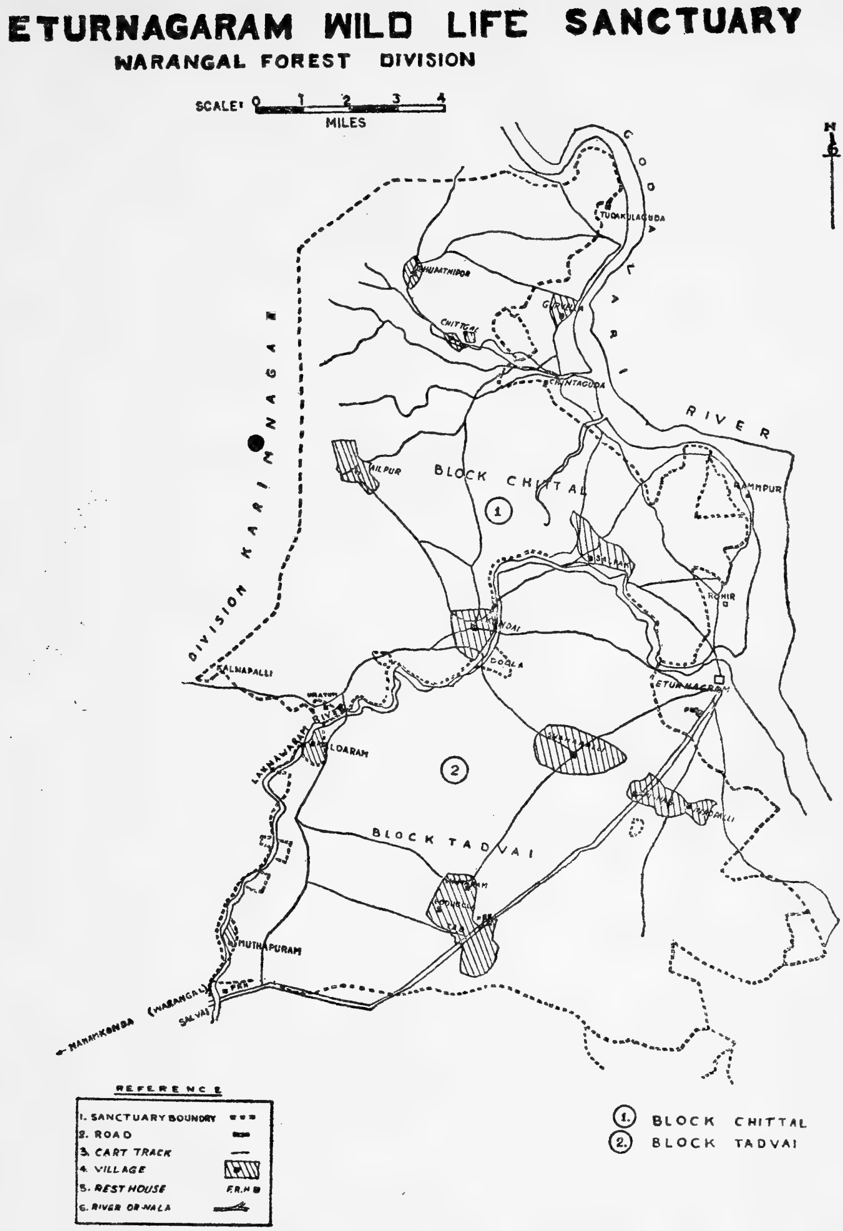
### Introduction

A 310-square mile area 40 miles north of Hanamkonda in the Warangal Forest Division, Warangal District, was constituted in 1953 by the Government of the State of Hyderabad as the Eturnagaram Wild Life Sanctuary. This extensive area covers the entire forest blocks of Chittal and Tadvai. The Godavari River forms the eastern boundary of the sanctuary and the other three sides are demarcated by boundary lines through the forests. However, similar to the situation in the Pakhal Wild Life Sanctuary, little more has been done for the protection or management of the Sanctuary's wild life than to prohibit legal shooting. Extensive forest exploitation, domestic livestock grazing and other activities have been and are presently being practiced inside the sanctuary. There are 44 villages, with a total cattle population of almost 10,000 head, in Eturnagaram. In addition, a few professional graziers also operate in this area. In spite of these many activities, many parts of the sanctuary are still relatively little spoiled by man and provide prime wild life habitat.

It is presently proposed by the Forest Department that the Eturnagaram Wild Life Sanctuary be reduced in size to a more manageable unit. This would consist of an approximately 150-square-mile area, the Tadvai Forest Block, south of the Laknavaram River. The Laknavaram would then form both the northern and western boundaries of the sanctuary and the Godavari River the eastern boundary. The Tadvai Reserved Forest would adjoin the sanctuary to the south (Map 2). The Chittal Forest Block north of the Laknavaram is relatively inaccessible, particularly during the monsoon season. It also contains a larger number of forest villages than does the Tadvai Block. The main road from Hanamkonda passes through the Tadvai Block and the sanctuary's three forest rest houses are located along this road. Therefore, it appears that the Forest Department is wise in attempting to concentrate their efforts in the preservation and management of this more restricted area as a true wild life sanctuary, rather than to retain a more extensive area as a wild life sanctuary in name only.

### Ecology

The Eturnagaram Wild Life Sanctuary is located at an elevation of about 251 feet above sea-level. Although there are a number of ephemeral streams inside the sanctuary, the Godavari and Laknavaram rivers are the only source of perennial water. Rainfall is monsoonal (June-September). Data as to the average annual precipitation, and maximum and




Map 2. General Map of the Eturnagaram Wild Life Sanctuary, Andhra Pradesh. It is presently proposed that the sanctuary be reduced in size to include only the Tadvai Forest Block south of the Laknavaram River.

minimum temperatures for this area are not available. However, the more luxuriant vegetation indicates that Eturnagaram receives more rainfall than does Pakhal, even though it is only about 30 air miles away.

**Flora**

The forests of Eturnagaram are classified as southern dry mixed deciduous, the same as for Pakhal, but they are more dense and have an average height of 40 to 60 feet. Second and third class teak, *maddi* and *tirman* are the predominant tree species in Eturnagaram. In contrast, teak is relatively uncommon in most parts of Pakhal. The proportion of other tree species, such as *anduk*, *billu*, *sundra*, *tapsi*, and so forth, are more or less the same for the two areas. However, the undercover is more dense in Eturnagaram and *Dendrocalamus strictus* predominates.

**Fauna**

In general, animal life (including birds, mammals, and reptiles) is similar for both Pakhal and Eturnagaram Wild Life Sanctuaries. However, large mammals are presently more abundant and more readily seen in Eturnagaram. Also, gaur are common in Eturnagaram while absent in Pakhal, and blackbuck are probably absent in Eturnagaram but present in Pakhal. Little is known concerning the species of fish in the Godavari and Laknavaram Rivers in the vicinity of Eturnagaram.

We observed fair numbers of sambar, chital, and nilgai during the afternoon and evening of November 19. The presence of gaur was also very much in evidence. The following morning the Forest Department conducted a beat or *haka* along the western edge of the sanctuary. We arose prior to 4 o'clock in the morning and quietly took our positions as 'counters' in machans along a cleared line through the forest. At dawn, over 500 men (some 450 villagers + 50 Forest Department personnel) moved systematically through a one-square-mile forest area. 'Stoppers' had been placed at strategic locations along the sides and the 19 'counters' recorded the animals that crossed the cleared line to the right of their machans. The operation was the third conducted in this area during the past four years. Such checks give an indication of trends in wild life populations and should be repeated at yearly intervals. Everything was well-planned and executed. The total count for large mammals in this square mile was : 1 barking deer, 8 chital, 5 sambar, 1 male gaur, and 2 sloth bear.

## Visitor Facilities

The city nearest to the Eturnagaram Wild Life Sanctuary is Hanamkonda, 40 miles south of the western boundary. The nearest railway station is at Kazipet (Warangal) adjoining Hanamkonda. The road from

Hanamkonda to the western edge of the sanctuary is black-topped and the P.W.D. road, which crosses the southern part of the sanctuary to the Eturnagaram Forest Rest House, is metalled. There are an additional 10 or 12 miles of metalled roads inside the sanctuary, as well as an estimated 160 miles of jeepable roads or cart tracks. At present the only means of transport to or within the sanctuary is by private vehicle.

There are three rest houses in the Eturnagaram Sanctuary area. Tadvai has one suite and Eturnagaram and Salvai each have two. Information concerning the sanctuary or reservations for the forest rest houses at Tadvai or Eturnagaram can be obtained from the Warangal Divisional Forest Officer in Warangal. Salvai, as well as the Traveller's Bungalow with four suites and all facilities in Hanamkonda, is under the jurisdiction of the P.W.D. Divisional Engineer in Warangal. In addition to the rest houses at Eturnagaram, there are also residential quarters and 17 Forest Guard Stations for the sanctuary staff, which consists of a Deputy Range Officer and 15 Forest Guards.

## Discussion

Eturnagaram has the potential of becoming an outstanding wild life sanctuary. However, primarily due to its relatively inaccessible location and the fact that there are no notable scenic or archaeological attractions near-by, the immediate development of this area as a major tourist attraction probably should not be initiated at the present time by the Forest Department. Nevertheless, immediate steps should be taken to preserve and protect this area so that it may some day achieve its full potential as one of India's notable wild life sanctuaries. Such measures should entail: the strict control of livestock grazing within the sanctuary; if possible, the forest villages inside the Tadvai Forest Block should be relocated outside the sanctuary or at least settled or cultivated areas in the sanctuary should be restricted to their present limits; that the sanctuary staff be indoctrinated in the basic concepts of wild life conservation and be made aware of the value of the wild life resources under their jurisdiction; and that existing facilities, i.e. roads and rest houses, be maintained and gradually improved. Also, if forest exploitation is continued within the sanctuary, wild life should be carefully considered in the Forest Department's working plans. Wild life is an important and integral part of the State's forest resources and like the trees should be managed for the greatest benefit for the greatest number of people in the long run. Visitor books, as well as a record of wild life observations by the staff, should be maintained in the sanctuary. Wild life studies should be encouraged in this area and regular inventories or checks, such as the 'hakas' conducted during recent years, should be continued so that the Forest Department will have a sound basis upon which to formulate management plans.

## IV. OTHER WILD LIFE AREAS IN ANDHRA PRADESH

### The Qawal Wild Life Sanctuary

A 200-square-mile area in the Jannaram Forest Range, Mancherial Division of Adilabad District, was declared a wild life sanctuary in June 1964. The nearest airport is at Hyderabad (Begumpet) 180 miles to the north. The nearest railway station is at Mancherial, 40 miles to the south-east. Regular scheduled buses are available from Mancherial to the sanctuary. Forest rest houses are available at Jannaram and Birsaipot. Information or reservations can be obtained from the Jannaram Divisional Forest Officer in the Adilabad District. Although I did not have the opportunity of visiting this sanctuary, it is reported that tiger, leopard, sloth bear, wild boar, sambar, chital, barking deer, nilgai, and blackbuck are among the animals that inhabit this area.

### Kolleru

Kolleru Lake in the West Godavari District, which is under the jurisdiction of the Public Works Department, is a notable area for water birds. Of particular interest are the large concentrations of spotted-billed or grey pelicans, as well as migratory waterfowl during the winter, on or in the vicinity of this lake.

The pelicanry is situated between the towns of Ganapavaram and Undi in West Godavari District. It is 7 to 8 miles from Kolleru Lake.

December to February is the best season to visit the pelicanry.

Accommodation for visitors is available at Ganapavaram, Undi, Akkivedu and Bhimavaram in the existing travellers' bungalows.

### The Pocharam Wild Life Sanctuary

This sanctuary could be developed into a bird sanctuary. There is a tank in the notified area and efforts are being made to develop it into a bird sanctuary. Pocharam is in Medak District.

### Nehru Zoological Park

The Nehru Zoological Park in Hyderabad is not, strictly speaking, a wild life area. However, over 135 species of wild birds have been recorded during recent years within its 302-acre walled-in enclosure. Good numbers of waterfowl may also be observed in the zoo's ' bird sanctuary ' during the migratory season. I also observed several free roaming troops of bonnet macaques (*Macaca radiata*) within the zoo's confines. However, the large number of both endemic and exotic forms of animal

life belonging to the garden deserves mention. To a great extent these animals are housed in modern enclosures, rather than in cages.

The zoological park is supervised by the Forest Department. Although it was started only recently in 1959 and is still in the developmental stages, it already presents a notable collection of animals. The setting is unique. A 13,200-foot solid masonry wall encloses a beautiful desert scrub forest and on one end abuts the Miralam Tank, a 400-acre lake formed by an arched masonry dam built in 1806. Added attractions include : a swimming pool, boat, elephant, camel, goat cart and pony rides ; a house-boat available for parties on the lake and two well-furnished guest houses overlooking the lake. Reservations for the house-boat or guest houses may be made through the Curator stationed in the park.

## V. Acknowledgements

I wish to thank Mr. P. S. Rao (Chief Conservator of Forests) and the Forest Department for their assistance and gracious hospitality during my brief tour of some of the notable wild life areas in Andhra Pradesh. Particularly I am grateful to Messrs. Mazharuddin Ahmed (Deputy Chief Conservator of Forests), M. S. Khan (Warangal Circle Conservator of Forests), A. V. R. G. Krishnamurthy (Karimnagar East Divisional Forest Officer), P. Kumar (Curator, Nehru Zoological Park), as well as to other Forest Department personnel too numerous to mention individually. Without exception all were very hospitable, patiently answered my numerous questions, and attempted to give me a true picture of the status of the wild life in the areas under their jurisdiction.

## VI. References

Gee, E. P. (1962) : The Management of India's Wild Life Sanctuaries and National Parks. *J. Bombay nat. Hist. Soc.* **59** (2) : 453-466.

# Wild Life in Gujarat State[1]

BY

J. JUAN SPILLETT

(*With four plates and two maps*)



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TABLES

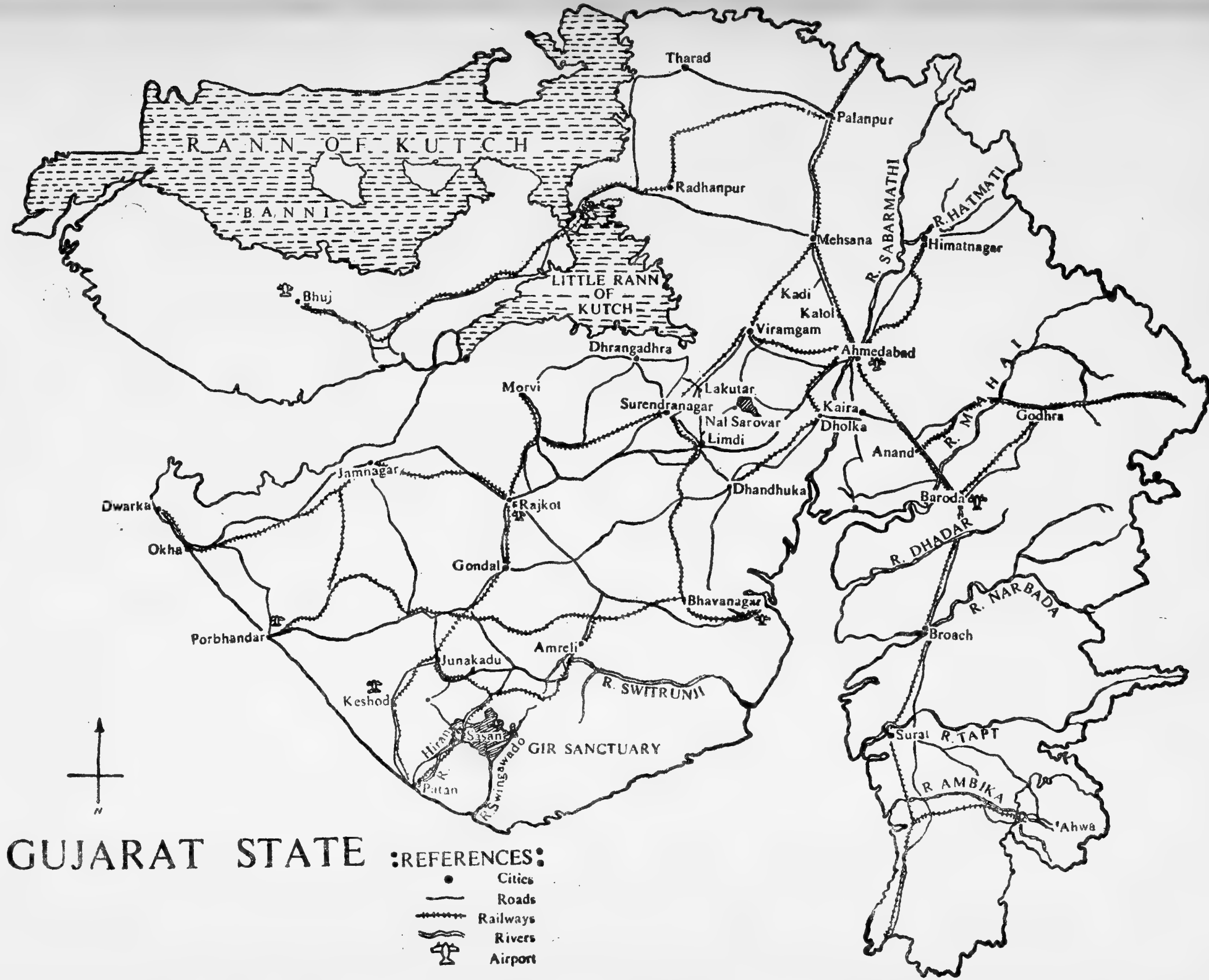


## I. INTRODUCTION

The State of Gujarat in north-western India comprises three geographical regions : (1) the Kathiawar Peninsula, jutting out into the Arabian Sea and traditionally known as Saurashtra ; (2) Kutch, the lowlands in the north bordering West Pakistan and Rajasthan, including the barren desert wastes of the Little and Great Ranns ; and (3) the mainland of Gujarat, between the rivers Banas and Damanganga. Typical natural vegetation for most of the State is desert scrub. The Gir Forest, a dry deciduous stunted or scrub forest of relatively little commercial value, is the only extensive forest area in this part of Gujarat. Annual rainfall varies between 25 and 50 inches (65-127 cm.) for most of the State. The arid zones of Surendranagar and north Gujarat receive even less. Mountainous regions are comparatively lacking, although steep, barren and rocky hills dominate the skyline in many parts.

Relatively little wild life is presently found in Gujarat. However, the State has the distinction of harbouring three extremely rare faunal species. The Gir Forest in the Junagadh District, is the last stronghold of the Asiatic Lion [*Panthera leo persica* (Meyer)]. The Indian Wild Ass (*Equus hemionus khur* Lesson) is almost completely restricted to the Little Rann of Kutch. The Great Indian Bustard (*Choriotis nigriceps* Vigors) was formerly distributed throughout most of the Indian Union, but now appears to be restricted to a few isolated areas in Gujarat and neighbouring States. In addition, the Great Rann of Kutch is the only known nesting ground in India of the Flamingo (*Phoenicopterus roseus* Pallas).

The last ' census ' of the Gir lions was conducted in 1963. At that time the total population was determined to be about 285 lions. Mr. E. P. Gee undertook a survey in 1962 to determine the status of the Indian Wild Ass. He then estimated a total population of 870 asses, of which all but about 10 permanently resided in the Little Rann. The Great Indian Bustard is extremely rare and apparently on the verge of extinction. Facts concerning its present or even recent distribution and numbers are not available.




# GUJARAT STATE

:REFERENCES:

- Cities
- Roads
- Railways
- Rivers
- Airport

# GIR SANCTUARY

## II. THE GIR WILD LIFE SANCTUARY

### Introduction

The Gir Forest covers an area of over 500 square miles (1,334 sq. km.) in the centre of the Kathiawar Peninsula of Gujarat. Over 480 square miles (313,459 acres) of Reserved Forest were officially designated as the Gir Wild Life Sanctuary in September 1965 (Agriculture and Co-operation Department, Notification No. GH-KH/97-WLP/660/62848-P, Sachivalaya, Ahmedabad, 18 Sept. 1965).

Besides being the only extensive forest tract in this part of Gujarat, the Gir is particularly noted for being the last stronghold of the Asiatic Lion. Lions appear to have ranged over the whole of Central Europe in prehistoric times. During historical times they were spread from Greece and Palestine, throughout the Middle East, including Mesopotamia, Persia, and Baluchistan. In India they inhabited practically the whole of the northern and central parts of the country, extending from Sind to Bengal and from the Ganges and Indus to the banks of the Narbada. During the early 1800's they were still abundant in many parts of India, but by the latter part of the century were only sporadically reported from a few areas in northern and western India. It appears that by the early part of the 20th century most of the few Asiatic Lions that remained were confined to the vicinity of the Gir Forest. Measures were finally taken to halt the indiscriminate slaughter of the lion. As a result, their numbers have gradually increased until presently it is claimed that there are about 285 in the Gir Sanctuary.

Rather than keep all their ' lions in one basket ' the Forest Department captured three specimens (one male and 2 females) and released them in the Chakia Forest south-east of Banaras in Uttar Pradesh in 1957. This is within the precincts of the Chandraprabha Wild Life Sanctuary and was reported to be a favourable area for the re-introduction of the lion. Although this attempt did not prove as fruitful as was expected, there are reliable reports of lion being sighted in this area as late as the fall of 1966 and the transplant may yet prove successful.

### Ecology

The terrain of the Gir Wild Life Sanctuary consists of steep, rocky hills with deep ravines or *nullahs*. The maximum elevation is 1741 feet above mean sea-level. The primary sources of perennial water are the Hiran, Singoda, Ardak, Machhundra and Rawal rivers. The Hiran passes near the Forest Bungalow at Sasan and the Raval is located in the southern part of the sanctuary. In addition, a number of scattered water-holes provide water during much of the year. These are located

along the rocky *nullahs*, which serve as watercourses for the numerous ephemeral streams. Wells and water troughs have been provided in many parts of the sanctuary by the graziers for their livestock. In 1958 the Kamleshwar Dam was constructed across the Hiran River several miles upstream from Sasan. This normally impounds a several square mile lake, but was practically dry during my visit.

The average annual rainfall in the Gir is normally about 35 inches (889 mm.). However, only 20 inches of precipitation were recorded during 1965 and 17 inches during 1966. Rainfall is monsoonal and, although somewhat irregular, the rains generally begin in early July and end by late October. Occasional showers often occur in January and February, but at least six months of the year are usually completely dry. The maximum and minimum temperatures are 106°F. and 46°F. in May and January respectively. However, temperatures of over 100°F. (37·8°C.) are common during the summer (April-July) and minimum temperatures during the winter (November-March) rarely drop below 55°F. (12·8°C.).

## Flora

The Gir is predominantly a dry mixed deciduous forest. Near the extremities it becomes an open thorny scrub type, comparable to the vegetation in many desert areas of the State. Teak (*Tectona grandis*), although poor in size and quality, accounts for over 50 per cent of the tree stand on the better soils. *Babul* (*Acacia arabica*) is also abundant and probably accounts for about 25 per cent of the total tree growth. Other species present include: *sadad* (*Terminalia tomentosa*), *behda* (*T. belerica*), *tendu* or *timru* (*Diospyros melanoxylon*), *haldu* (*Adina cordifolia*), *sissam* (*Dalbergia sissoo*), *khair* (*Acacia catechu*), *karanj* (*Pongamia pinnata*), *siris* (*Albizzia lebbek*), *krangsa* (*A. procera*), *mahuda* (*Madhuca indica*), *anvla* (*Phyllanthus emblica*), *aritha* (*Sapindus emarginata*), *garmala* (*Cassia fistula*), *jamun* (*Syzygium cumini*), *khakra* (*Butea monosperma*), *kudi* (*Wrightia tinctoria*), *aal* (*Morinda tinctoria*), *salie* (*Boswellia serrata*) and some patches of bamboo (*Dendrocalamus strictus*) in moist areas along the *nullahs*. Also, a few Eucalyptus have been planted by the Forest Department. There are few climbers, but thorny bushes or shrubs are commonly intermingled with the trees. These consist primarily of *Acacia* spp., *ber* (*Zizyphus mauratiana*), *guggal* (*Commiphora mukul*), and so forth.

The trees in the Gir Forest, with very few exceptions, lose their leaves during the dry season (December-July). The scattered 'Flame of the Forest' or *khakra* (*Butea monosperma*), *simul* or *semal* (*Bombax ceiba*, formerly *Bombax malabaricum*), and *kadaya* or *karaya* (*Sterculia urens*) are then particularly evident because of their bright red blossoms, which contrast markedly with the stark absence of leaves.

**Fauna**

Bird life is abundant in the Gir Sanctuary and most of the species found here are ably described in K. S. Dharmakumarsinhji's book BIRDS OF SAURASHTRA (1955). Among the more obvious birds observed during my short visit were : Bonelli's eagle, crested hawk eagle, white scavenger vulture, whitebacked vulture, Indian pond heron or paddy bird, Indian black ibis, common grey partridge or francolin, Indian roller, cattle egret, wood sandpiper, redwattled lapwing, Indian roseringed parakeet (nest in the Forest Bungalow), Indian spotted dove, peafowl, common green bee-eater, hoopoe, blackheaded cuckoo-shrike, Dharmakumars' small minivet, drongo, Indian brownbacked robin, Indian magpie robin, redbreasted flycatcher, jungle crow, treepie, jungle babbler, redvented bulbul, pied bushchat, yellowheaded wagtail and common myna.

Reptiles present in the Gir Sanctuary include ; common cobra (*Naja naja*), Indian python (*Python molurus*), monitor (*Varanus* sp.), mugger (*Crocodilus palustris*), as well as undetermined species of lizards and turtles. A number of small species of fish were also observed in the Hiran River, but none of these would be of importance either commercially or for sport.

Mr. P. K. Pandya, the Tourist Department Receptionist at Junagadh, has been conducting tours to the Gir since January 1964. During his numerous visits to the sanctuary he has observed many species of mammals and has become acquainted with their local or gujarati names. With his aid a table was compiled listing the mammals of the Gir Wild Life Sanctuary and their local names (Table 1).

## Visitor Facilities

The nearest airport to the Gir Wild Life Sanctuary is at Keshod, 42 miles (67 km.) by jeepable road north-west of the Forest Bungalow at Sasan. A better road is via Veraval, 61 miles. Four flights per week (Sunday, Tuesday, Thursday, and Saturday) arrive at Keshod from Bombay. Transportation to Sasan and return may be arranged by prior notification to the Sanctuary Superintendent. Sasan may also be reached by overnight metre-guage train from Ahmedabad, via Khijadia Station. The railway station at Sasan is only several hundred yards from the Forest Bungalow. Regularly scheduled Tourist Department tours of the sanctuary may likewise be taken from Junagadh, approximately 50 miles north of Sasan via Mendarda.

The Forest Bungalow at Sasan has 16 double rooms and modern facilities, including electricity. Both food and lodging are provided at nominal fees. A dormitory that can accommodate up to 40 people was added recently to the facilities at Sasan. Reservations for food and/or lodging at Sasan and transportation to and within the sanctuary should

be made by writing to the Sanctuary Superintendent in Sasan-Gir at least two weeks prior to arrival. Two vehicles are presently provided

TABLE 1

NAMES OF SOME OF THE MAMMALS INHABITING THE GIR WILD LIFE SANCTUARY, GUJARAT

| English | Local or Gujarati | Scientific |
|---|---|---|
| Common Langur | Vandara | *Presbytis entellus* |
| Asiatic Lion | Untia Bagh (camel tiger) Sinha (male) Sinhan (female) | *Panthera leo persica* |
| Leopard or Panther | Dipado (male) Dipadi (female) | *Panthera pardus* |
| Jungle Cat | Bilado (male) Biladi (female) | *Felis chaus* |
| Small Indian Civet | Vaniyar | *Viverricula indica* |
| Common Mongoose | Noliyo | *Herpestes edwardsi* |
| Striped Hyena | Jarakh | *Hyaena hyaena* |
| Wolf | Varu | *Canis lupus pallipes* |
| Jackal | Siyal | *Canis aureus* |
| Indian Fox | Lonkadi | *Vulpes bengalensis* |
| Ratel or Honey Badger | Ghorkhodiya | *Mellivora capensis* |
| Five-striped Palm Squirrel | Khisakoli | *Funambulus pennanti* |
| Indian Porcupine | Shahudi | *Hystrix indica* |
| Indian Hare | Sasalu | *Lepus nigricollis* |
| Chinkara or Indian Gazelle | Shikara | *Gazella gazella* |
| Blackbuck or Indian Antelope | Kaliyar | *Antilope cervicapra* |
| Four-horned Antelope or Chousingha | Ghatudu | *Tetracerus quadricornis* |
| Nilgai or Bluebull | Rose (male) Rasadi (female) | *Boselaphus tragocamelus* |
| Sambar | Sabar | *Cervus unicolor* |
| Chital or Spotted Deer | Tipkivalaharan | *Axis axis* |
| Indian Wild Boar | Suvar | *Sus scrofa* |
| Indian Pangolin | Salvo | *Manis crassicaudata* |

for the use of visitors. Most of the sanctuary's 300 miles of roads are metalled and are maintained by the Forest Department. Although the sanctuary can usually be reached throughout the year, travel sometimes becomes difficult on these fair-weather roads during the monsoon (July-October). Crossing on some of the ravines or *nullahs* become particularly uncertain. A tar road leads from Veraval to Talala, 14 miles south of Sasan, as well as from Junagadh to Veraval via Keshod. The next closest tar road ends at Mendarda, 24 miles north-west of Sasan.

The best season for visitors to the Gir is from January until May. Weather conditions are rather uncertain during June. Although good weather can generally be expected during November and December, because of the high grass and dense undergrowth, the animals are usually rather difficult to observe during these months. The best time to see the maximum number of wild animals is during the dry season. However, temperatures from April until the monsoon breaks in late June or early July often exceed 100°F. (38°C.).

The ' lion shows ' are the outstanding attraction in the Gir Sanctuary. These are scheduled for a minimum fee of Rs. 80 per group of from 1 to 8 visitors. Each additional person is charged Rs. 10. On the second Sunday of each month the fee is Rs. 10 per person, regardless of the number of visitors in the party. Prior to July 1966 the minimum fee was Rs. 150 per ' lion show ' for each group of 20 or part thereof. The number of ' lion shows ' presented to visitors increased from 192 in 1963 to 236 in 1964 and 292 in 1965. The number of visitors recorded by the Forest Department varied from 3,645 for 1963-64 to 3,530 for 1964-65 and 4,377 for 1965-66. The decrease in 1964-65 can be attributed to the Indo-Pakistani conflict. In all cases less than 10 per cent of the total were foreigners. Tourist Department tours from Junagadh also brought over 2,000 Indian and 240 foreign visitors to the sanctuary in 1965.

Twelve ' shikaris ' are permanently employed in the Sanctuary to track or locate lions for visitors. The ' shikaris ' are assigned regular beats and during the morning attempt to locate groups or prides of lions within a 15-mile radius of Sasan. If necessary, they lead the lions with a bait to an area more easily accessible to visitors. Then, during the afternoon or early evening, they guide the visitors to the lions. The ' shikaris ' are excellent trackers and claim to ' know ' about 30 individual lions within the vicinity of Sasan. These lions can usually be observed and photographed by visitors on foot at distances of less than 50 feet.

The historic temple of Somnath near Veraval is of interest, as well as the two near-by holy places of the Hindus—Bhalka Teerth and Dehotsarga. The earthly remains of the most popular God of the Hindus, Lord Krishna, were supposed to have been cremated here. Three Hindu temples are also located in the Sanctuary. Satadhar is approximately 16 miles north-east of Sasan. Kankai is about 17 miles south-east. And Tulsishyam is also south-east about 50 miles. Free board and lodging are reportedly provided for pilgrims to these shrines.

Forest Department personnel assigned to the Gir Wild Life Sanctuary and charged with assisting and providing for the needs of visitors consist of a Sanctuary Superintendent assisted by other officers and staff totalling 42.

## Discussion

The Gir Wild Life Sanctuary presents one of the most interesting wild life areas in India. Besides being the last stronghold of the Asiatic Lion and the only extensive forest area in this part of Gujarat, its numerous faunal forms are impressive and deserve major consideration. It is true that some of the lions prey upon domestic livestock. However, other wild animals, such as deer, antelope, and pig, form the basic food

supply for the lion and without their presence in fair numbers the survival of the lion would be highly jeopardized. Thus, the preservation of the Gir lions entails the proper management of all the sanctuary's wild life, including the floral as well as faunal forms.

The 1965 Act which designated the major portion of the then Gir Reserved Forest as a wild life sanctuary is highly commendable. However, as was recommended by the Indian Board for Wild Life in 1963, it is hoped that shortly the Gir will be upgraded to the official status of a national park. This action of merely converting the status of the sanctuary would provide two basic advantages. First, a national park necessitates an Act of the State Legislature and can only be unmade by an Act of that legislature. On the other hand, a sanctuary can be formed by a gazette notification and can as easily be unmade. Therefore, a national park is much more immune to adverse changes in policies and to political expediency. Second, designating an area as a national park gives it greater prestige and indicates, particularly to foreign tourists, that it is an area of national significance. The Gir has the potential of being one of India's outstanding national parks and this potential should be realized as soon as possible.

The ideal faunal national park is as free as possible from human activities, such as settlements, cultivation, forest exploitation, livestock grazing and so forth. These problems will be discussed briefly. However, it does not follow that because some of them are present in an area it cannot become a national park.

**Cultivation**

The present human population within the confines of the Gir Wild Life Sanctuary, in my opinion, is not excessive. Although located in the Gir Forest, 3,000 acres belonging to the Dharmada Institution of Tulsishyam and 863 acres pertaining to the villages of Sasan, Najanpur Chhataria, Karasangadh and Gundiyah were excluded from the sanctuary when it was established in 1965. Of the latter 863 acres, 87 pertain to village sites and 776 are cultivated lands. These lands have been demarcated and are limited to their present size.

Major crops are cotton, millet, corn or maize, and wheat. The soils in this region are rocky and for the most part can probably be classified as submarginal agricultural lands. Therefore, there is little justifiable reason to permit additional lands to be cleared for cultivation. If the cultivated areas are strictly limited to their present confines, they should not be a deterrent to the establishment of the Gir Sanctuary as a national park. Probably of greater significance than cultivation are other practises of the people within the sanctuary, such as the grazing of livestock, the use of 'crop protection' guns and the occasional use of poisons or other means for killing lions and other wild life.

**Livestock Grazing**

In addition to permanent village sites, temporary villages or camping places called 'nesses' are common throughout the Gir Sanctuary. Graziers or 'maldharis' centre their extensive livestock grazing operations around these. Some of the sanctuary's principal 'nesses' are Kansia, Sandhbeda, Devalia, Kapuria, Gadakia and Dedakdi. Although their number is presently specified, they may be shifted from one site to another by permission of the Range Forest Officer.

It is estimated that there are over 500 families of 'maldharis' in the Gir and that they graze over 15,000 head of livestock. Goats and sheep, with the exception of a special permit for about 200 goats near Sasan, are supposedly prohibited. However, I counted over 300 head in two flocks west of Sasan. The number of cattle or buffalo is not specified. The only requirement is that a very nominal grazing fee for adult animals (50 paise per adult buffalo and 25 paise per adult cow) must be paid to the Forest Department. Young or immature animals are permitted free of charge. There are no further restrictions as to the number of cattle or buffalo that are grazed, as long as the grazing fees are paid.

Where there is good grazing for wild ungulates there is also good grazing for domestic livestock. If domestic livestock grazing cannot be excluded from an area dedicated to the preservation of wild life, then the problem is to reconcile the two diverse objectives. This demands that grazing be controlled and regulated under a policy of wise land use. And, in most cases, this means a reduction in the number of domestic animals. There were some areas observed in the Gir which appeared to be almost completely untouched by domestic livestock. However, almost without exception, areas surrounding the permanent villages and 'nesses' were severely overgrazed for considerable distances into the forest. The recent and prolonged drought is undoubtedly a factor to be considered. Nevertheless, in any case the carrying capacity of the forage should never be exceeded. Forage resources should be carefully and periodically evaluated and measures then taken to ensure that the carrying capacity is not surpassed by either domestic or wild ungulates.

When nature is abused she often retaliates with drastic actions. Once choice lands throughout much of the world are now barren and rocky deserts because of the abuses of man and his livestock. Particular care must be exercised in arid areas, such as the Gir Forest. Only a year or two of excessive overgrazing in such areas may result in habitat destruction that may take nature a century or more to repair—even with complete protection.

Good forage conditions will result in better production of both milk and work by domestic animals, as well as help to maintain the animals in a healthy and vigorous condition. The incidence of diseases and parasites in both domestic and wild animals likewise will be reduced,

Also, the maintenance of good numbers of wild ungulates will reduce the number of domestic animals taken by lion. This in turn will reduce the amount of compensation that the Forest Department has to pay to villagers or 'maldharis.' Thus, Rs. 7000-8000 per year, paid for livestock compensation during 1965, could be put to better use in developing the sanctuary. In short, there is much to be gained through proper land use, which includes the control of livestock numbers. But, literally all can be lost if the present trend of ever increasing numbers of domestic livestock is permitted to continue.

**Forest Exploitation**

Wild life is an integral part of any natural forest. As such it deserves full consideration in all forest operations or exploitation. Forest management involves wild life management and vice versa. Under proper management both the forests and their wild life are managed so as to provide the greatest benefits to all concerned over a sustained period of time. Nevertheless, proper management will vary remarkably from one area to another. For example, forest produce will rightfully receive prior consideration in some areas, while wild life may be considered only as a by-product. In other areas, particularly those set aside as wild life sanctuaries or national parks, the wild life should receive major consideration and the forests in many cases may not be exploited at all for produce. Generally speaking, however, the relative values of forest produce and wild life should be carefully considered. Then, in so far as is possible, both should be managed on a sustained yield basis.

The forests of the Gir Sanctuary are extensively exploited for produce. Although very few of the trees have much commercial value for lumber, they are utilized primarily for fire wood and small timber, which is used for light construction. Selected ' coupes ' are clear-felled and frequently replanted with teak. Livestock grazing is prohibited for several years on these recently cleared or teak plantation ' coupes ', but grass cutting is permitted on a contract basis. Minor forest produce is also of importance and includes such items as wild fruits, soap nuts, ' tendu ' leaf (used instead of paper for rolling cigarettes), gums, wild honey and so forth. These are usually collected on a permit basis by people living in or near the sanctuary.

I feel that it is impractical and illogical to advocate the cessation of all forest exploitation in the Gir Wild Life Sanctuary. However, the wild life should receive major consideration and all forest exploitation should be managed so as to interfere as little as possible with the function of the area as a wild life sanctuary.

It would be desirable if the Forest Department would demarcate and maintain a fairly extensive area free from all forest exploitation, including the grazing of domestic livestock. In other words, an inviolate

'Sanctum Sanctorum', which would provide a refuge for wild animals where they should be relatively immune to the disturbances of man. Preferably, this would be within the vicinity of the Forest Bungalow at Sasan. It would also permit visitors to view the unique wild life of this region in almost a pristine setting.

**Poaching**

The extent to which poaching is a problem in the Gir Wild Life Sanctuary is not known. It is difficult even to assess the severity of violations in an area as complex as the Gir. First, the Gir covers over 500 square miles of steep rocky terrain. Then, there are over 300 miles of roads within this area. These are used extensively as a thoroughfare or for removing produce from the forest, as well as by local villagers with their bullock carts and livestock. Thirdly, villages or 'nesses' are distributed throughout the forest and 'maldharis' and their livestock are found almost everywhere. The Forest Department staff is limited. Even if it were not, it would not be economically feasible continuously to patrol this vast area. Complex as the situation is, practical measures should still be as fully implemented as soon as possible to halt poaching and other illegal activities in the Gir Sanctuary.

The sanctuary staff claims that the most common form of poaching is from vehicles along the roads. Therefore, road blocks and periodic inspections of all vehicles passing through or leaving the sanctuary, particularly at night, would probably help to check violations of this type. Farmers within the sanctuary have 'crop protection' guns in their possession. These villagers should be made to understand that these guns are to be used only for their intended purpose and then only on private lands. Even the carrying of arms in the sanctuary proper should be considered as an offence. Likewise, except during the crop season, the use of 'crop protection' guns should be completely prohibited.

The use of pesticides or poisons by villagers to kill lion and other carnivora has been greatly reduced by a livestock compensation policy. Since 1964 the Forest Department has paid compensation for livestock killed by lions. When an animal is killed under particular circumstances, i.e., livestock must be corralled at night and accompanied by a herder while in the forest during the daytime, the owner must report the incident to the Forest Department. The Range Forest Officer must then inspect the kill to ascertain that it is a bona fide claim and to assess the true value of the animal. He then sends a claim to the Divisional Forest Officer, who reimburses the villager or 'maldhari' for his loss. The value of animals killed is based upon their utility and is said to be about half of what the owners generally claim. An average of between Rs. 250 and 300 per animal or a total of over Rs. 7000 was paid on claims during 1965.

All claims for livestock losses should be dealt with as fairly and as

quickly as possible so that the former methods of predator control will not be reverted to. The Forest Department should also work closely with the Agriculture Department to ensure that toxic materials are not indiscriminately distributed to villagers. Although the particulars were not available, it was reported that there were two or three cases of pesticides (including rat poison) being used to kill wild life in the Gir in 1965. There should be little reason for such incidents in the future if villagers are made aware of the policy of remuneration and if claims are justly dealt with. Nevertheless, precautions should be taken to ensure that they do not arise.

Three lion cubs were reported killed in August 1966. It was reported that villagers stoned and then drove their buffalo over the cubs, but this could not be proved. Another report stated that only one lion cub was killed. Therefore, the case could not be prosecuted. Laws should always be practical and just. Then the common people should be informed as to what the laws are, how they will benefit by abiding by them and the punishment involved in their violation. When evidence is sufficient, law breakers should also be prosecuted to the fullest extent of the law so as to serve as a deterrent to future infringements.

Each of the 12 ' shikaris ' or Game Keepers employed in the sanctuary is provided with an ancient muzzle-loading rifle. These arms are supposedly for the protection of visitors. However, those which I inspected probably provide little more than a false sense of security. These weapons should either be completely discarded or replaced with modern rifles that would effectively protect a visitor should, for some reason, a usually docile lion suddenly becomes violent.

Shots were heard on two occasions during my first visit to the Gir in 1965 and once in 1966. While investigating one of these a ' shikari ' came out of the bushes from which I had heard the shot. I was unable to communicate with him and I never did determine whether or not it was he that had fired the shot and if he had, for what purpose. This, however, raises a point. Muzzle-loaders use black powder, which is quite readily obtainable. Cartridges, on the other hand, are carefully controlled and accurate records of their sale are kept on file. Therefore, if the Forest Department replaced their muzzle-loaders with modern arms, their use could easily be checked.

Leopards are relatively common in many parts of the Gir. Although only infrequently seen, they are reported to visit Sasan and other villages almost nightly. On the other hand, lions rarely enter the villages. Leopards are also noted for being particularly fond of goats and dogs. Concerning the latter, the villagers in Sasan claim that because of their fear of leopards the dogs in the village take refuge at night either in the houses or on the roofs. What advantage a dog on a roof would have as compared to the climbing ability of a leopard I do not know. But I did

observe that although there were numerous dogs around the village during the daytime, they all seemed to disappear at night. This is rare in Indian villages where dogs are commonly underfoot no matter what the time of day. The villagers further claimed that leopards are probably the greatest enemy of young lions and that lion cubs are killed by leopards whenever they have the opportunity. If after careful investigation this proves to be the case, the Forest Department in some cases might be wise to control leopard numbers.

**Fire**

The Gir Forest is almost completely dry for at least six months of the year. During this period fires often become a problem. The primary sources of fire are sparks from the coal-burning trains, which pass through the sanctuary, and villagers or ' maldharis ', who sometimes set fires with the belief that it will improve grazing conditions during the coming year for their livestock. Some fires also appear to be accidental. The only means presently available for bringing these fires under control is the use of the sanctuary staff to fight them. An extensive area north of Sasan had burned prior to my arrival. As a result, the ground was completely barren and would not provide any forage or habitat whatsoever for either domestic or wild animals for at least another six months.

The Forest Department, during recent years, has wisely initiated a controlled burning programme along the railroad right-of-way. This has greatly reduced the number of fires from this source. Although almost any burning in an area as arid as the Gir is undesirable, it is a matter of limited burning under controlled conditions early in the season with relatively few adverse effects versus the possibility of devastating and extensive fires later. Villagers and ' maldharis ' should be indoctrinated as to the deleterious effects of burning and discouraged from setting fires in the forest. Those that maliciously set fires should be punished.

**Wild Life Management**

It has been demonstrated that it is practically impossible to eliminate completely some animal species from their natural habitats so long as they are provided near ideal conditions in abundance—including food, water, cover, and other necessities. Regretfully, the lion is not one of these species. His behavioural and other characteristics make him extremely vulnerable to modern man with the means of destruction which he has at his command. The lion in his natural state had no reason to fear any of the other animals. As a result he did not develop a secretive or silent attitude as is so common with many mammals. He also found that ' in unity there is strength ' and that his needs for food could be more readily acquired with the assistance of others of his kind. Thus he became a social animal and is only infrequently found

alone. However, both his lack of fear and his social nature in the presence of man have helped to eliminate him from the greater part of his former range. Now that man has shown his ' prowess ' in eliminating the lion from the whole of Europe and almost the whole of Asia, is it not time that he showed his benevolence to the remnants of this great beast? Without the aid and protection of man, the mere existence of the lion is imperilled, even in its last remaining stronghold in Asia—the Gir Wild Life Sanctuary.

The management of wild life is critically dependent upon available resources. Therefore, the first step in proper management in a wild life sanctuary is usually a wild life inventory or census. This may be simply a survey to discover what species are present in the area, regardless of numbers. Or it may be an enumeration, as well as a determination of the sex and age class composition of the species. The collection of such data is dependent upon the availability of trained man-power.

Forest Department personnel assigned the responsibility of managing a wild life sanctuary should be carefully selected. Only men with a genuine interest in wild life should be chosen. If at all possible, they should have at least some training in the basic concepts of the specialized field of wild life management. Sanctuary staff members, particularly senior members, should also be appointed for sufficient periods of time so that they can become intimately acquainted with the wild life and the problems in the areas under their jurisdiction. Likewise, they should have sufficient time and authority to remedy the problems which they may encounter and to initiate long-range improvement or management plans. The present Sanctuary Superintendent in the Gir has been posted less than a year and the Sanctuary Inspector just over a year. All too often men are transferred to other positions before or shortly after they have become oriented to the overall situation and prior to the time that they have been able to make genuine contributions to the management of their areas. Literature concerning wild life management should be made available within the sanctuary and the staff encouraged to become acquainted with it. The staff should also consult and work with wild life experts whenever the opportunity arises.

According to Forest Department reports the total lion population of the Gir was less than a dozen in the early 1900's. However, according to the Jam Sahib of Nawanagar, as reported by Gee (1964), the lowest number was probably not less than 100. The shooting of lion was finally prohibited in 1913, although official permits were still given to V.I.P. s to shoot specified quotas of lions. Fortunately this custom has been stopped and lions, as well as all members of the deer family, are now fully protected by the Government throughout Gujarat.

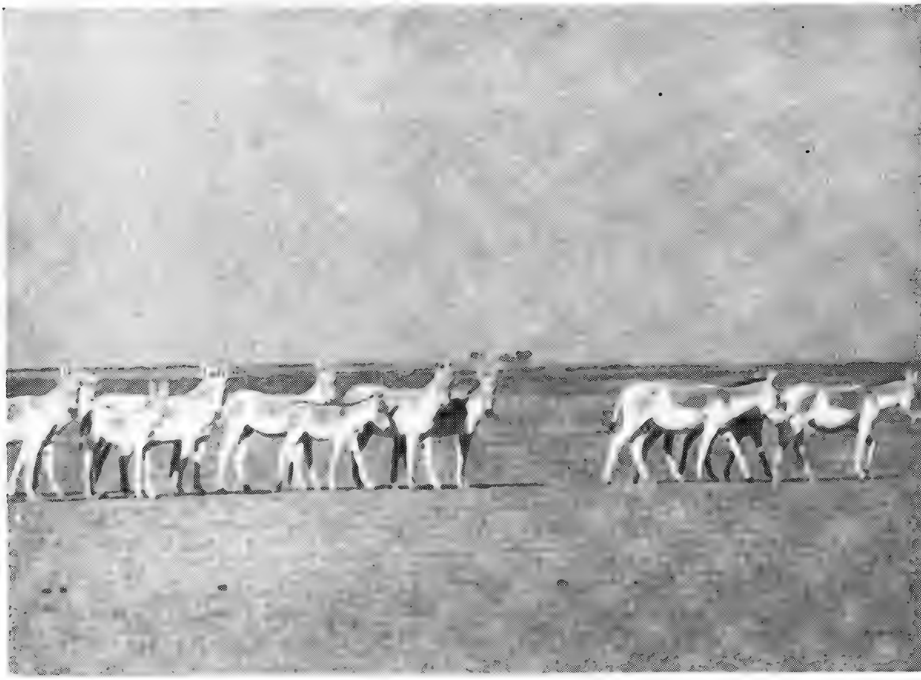
The first lion census in the Gir was conducted in 1936 and resulted in a total count of 287 lions. Further censuses carried out in 1950, 1954,

Spillett : Wild Life Surveys

*Above :* The "shikaris" in the Gir Wild Life Sanctuary claimed that this adult male lion, whom they called "Bhuria" was about 9 years old ; *Below :* An adult lioness "Mala Sinha" reported by the "shikaris" to be about 7 years old.

(*Photos : Author*)

Spillett : Wild Life Surveys



*Above :* A herd of Indian Wild Asses at the edge of the Little Rann Kutch ;
*Below :* Close-up of two Indian Wild Asses running at a speed of over 30 miles per hour in the baked-mud surface of the Little Rann.

(*Photos : Author*)

and 1963 determined the populations at about 227, 290, and 285 respectively. The sex and age class composition break down for the latest figure of 285 was 82 adult males, 134 adult females, and 69 young.

Lion enumerations in the Gir have been supervised by the late M. A. Wynter-Blyth, formerly principal of the Raj Kumar College at Rajkot. Mr. R. S. Dharmakumarsinhji, a notable authority on wild life, has also assisted. A method of counting tracks was employed in all cases. This was based upon three facts or assumptions : (1) Different lions can be identified by the pug marks of their front feet, i.e., the tracks of any two lions can usually be distinguished. (2) Lions generally walk along paths or roads through the forest, rather than cross-country. (3) Lions drink at least once during every 24-hour period. This is basically a sound method and should give fairly reliable estimates as long as enumerations are carefully planned and executed with well-trained personnel. However, without expert trackers and strict supervision the results may be subject to gross errors.

A number of reliable people of Gujarat who are well-versed in wild life have expressed the opinion that instead of 285 lions in the Gir Sanctuary there are probably only about 100 to 150. I am likewise of the same opinion. Although I saw only 14 different lions during my short visit to the Gir, I base my opinion primarily upon the relative scarcity of prey species which I observed. For example, during my 4-day visit I travelled over 250 miles by jeep inside the sanctuary. Most of this was during the early morning or evening when the opportunities for seeing wild life are generally quite good. However, the sum total of my observations were : 20 chital, 9 wild pig, 5 sambar and 11 four-horned antelope. Chinkara, nilgai or blackbuck were neither observed during my 1965 or 1966 visits. The ' shikaris ' also claim to be acquainted with only about 30 lions within about a 15-mile radius of Sasan. Many of these prey upon domestic livestock. In my opinion, prey populations in the Gir presently do not appear to be large enough to support even 200 lions, let alone 300. Enumerations of prey species in the Gir have been grossly neglected and, in so far as I am aware, have never been attempted. The Forest Department has been conducting their lion censuses at approximately 5-year intervals. It would be commendable if enumerations of other species, such as chital, sambar, etc., were conducted at the same time. The results would be of interest and of value if the enumerations are properly conducted. It would also be interesting to compare the results of a ' direct count method ' with lion, as advocated by M. A. Rashid, Conservator of Forests in Gujarat, as compared to the previously employed ' track count method.'

Other forms of wild life in the Gir Sanctuary should not be neglected. In addition to periodic enumerations of lions and other large mammals, checklists of birds, reptiles and smaller mammals in the sanctuary should

be compiled and made available both to the staff and to visitors. Likewise, wild life observations by both visitors and staff should be systematically recorded and kept on file inside the sanctuary. Scientific investigations concerning the sanctuary's wild life by qualified investigators should be encouraged. Their findings should be utilized in formulating management plans, as well as made available to the general public.

General maps depicting roads and places of interest in the sanctuary should be made available to visitors, as well as detailed maps depicting vegetation types, etc., for the staff and scientific investigators. Postcards, folders, booklets and other general information and propaganda should be compiled and distributed through the Tourist Department and other agencies so as to help people become aware of what the sanctuary has to offer. Preferably these should be sold at reasonable rates and would prove as an additional source of revenue for the sanctuary. Lions are admittedly the Gir's outstanding attraction, but its other attractions should not be overlooked. For example, many people would be interested in seeing mugger or crocodile in the Kamleshwar Lake or the Hiran River, as well as other wild life species, such as the four-horned antelope, chital, sambar and so forth. The near by temples or even some of the ' nesses ' may be of interest, particularly to foreign visitors.

The Forest Department of Gujarat is to be commended for its role in the preservation of the Gir Forest as a Wild Life Sanctuary. A firm base for future management has already been established. The task now is both to maintain and improve upon this base so that the Gir will attain its full potential and the distinction of being one of India's outstanding wild life areas, which it rightfully deserves. The ultimate goal should be perpetually to protect and preserve the wild life of the Gir, while at the same time providing as many people as possible the unique experience of observing wild life in its natural state.

## III. THE WILD ASSES OF THE LITTLE RANN OF KUTCH

### Introduction

The Indian Wild Ass apparently was once common in much of north-western India and what is now West Pakistan and south-eastern Iran, formerly known as Persia. It is now extinct in Iran and, with the exception of a few animals which may occasionally stray into south-eastern West Pakistan, it is presently restricted to the Little Rann of Kutch. Concerning its near relatives, Talbot (1960) considered the Syrian Wild Ass (*Equus hemionus hemippus* I. Geoffroy) as extinct and claimed that the wild asses of Egypt, the Sudan and other parts of Africa are probably feral rather than true wild asses. Sálim Ali (1946a) reported that in

1945 the Kiang or Tibetan Wild Ass (*E. h. kiang* Moorcroft) was common or abundant on the 15,000 foot-high Barkha Plain and in the neighbourhood of the lakes Manasarowar and Rakhas Tal in western Tibet. However, since the Chinese invasion little is known about the status of this species.

Valuable information concerning the Indian Wild Ass also was reported by Sálim Ali in 1946 when he conducted an expedition to the Little Rann. Wynter-Blyth (1956) described how six asses were captured for the Indian Army to be used for breeding purposes with mules. However, I have been unable to find out the results of this project. Dharmakumarsinhji (1959) likewise described the wild ass and presented observations concerning it and possible methods of censusing its numbers. In 1960 Sálim Ali reported the death of a number of asses to E. P. Gee. Some deaths of wild asses in 1958 were confirmed to be a result of surra[1]. Further deaths from surra in 1960 and the report of an epidemic of African Horse Sickness[2] in November and December 1961 prompted E. P. Gee to undertake the first real survey to determine the status of the Indian Wild Ass. This survey was initiated in February 1962 under the auspices of the IUCN (International Union for the Conservation of Nature and Natural Resources) and the World Wildlife Fund. The present report is a continuation of the survey initiated by E. P. Gee.

## The Little Rann

The Little Rann of Kutch in north-western Gujarat has to be seen to be believed. Weird mirages are continually visible in this flat sterile desert which covers an area of approximately 1,000 square miles. Although a vast barren waste, the Rann has a unique enchantment. Heat shimmer in the intense sunlight of the dry season (October-June) obscures anything beyond about half a mile. Visible objects beyond several hundred yards often appear to float in the air and assume peculiar shapes. Wild asses often appear to be walking in a shimmering sea with their reflections mirrored below. Many objects are also greatly magnified and take on grotesque proportions. For example, we once sighted what appeared to be a long line of large animals in the distance.

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[1] Surra—an arthropod-borne disease of horses and other animals caused by a protozoan blood parasite *Trypanosoma evansi*. The disease is usually fatal to horses unless an injection of arsenical preparations is given. Prophylactic doses give an immunity of about six months. Common vectors are horse-flies of the family Tabanidae.

[2] African Horse Sickness—a virus disease of equines which has been known for a long time in Africa. However, in recent years it spread across the Middle East and first entered India in either 1959 or 1960. It is generally transmitted by biting midges of the genus *Culicoides*. Horses may be made immune to the disease for periods of about six months by inoculation. Those which recover from the disease are also immune.

Approaching closer with the jeep these figures assumed major proportions and appeared much like a series of large block houses. Finally, upon closer examination it was determined that they were nothing more than the tracks of wild asses and the irregularities caused when they crossed the table-flat desert surface when it was muddy.

Only a few scattered hillocks or islands, locally called 'bets', break the monotony of the flat, salt-cracked terrain of the Little Rann. The largest of these is the somewhat centrally located 18 to 20-square-mile Pung Bet. Sâlim Ali considered this 'bet' as the 'headquarters' for the Indian Wild Ass during his 1946 expedition. However, he also stated that the relatively small 'bets' of Vachhda and Jhilandan were probably the only source of perennial water within the Rann and the asses shifted to them from Pung Bet about the middle of March. Other 'bets' include Nanda, Mardakh or Merdhak, Kesmari and Zilanand or Jalander, as well as a number of smaller 'islands'.

Rainfall in this region is only 5 to 15 inches per year. A number of rivers, such as the Banas, Rupen, Bambhan and Mechhu, flow into the Rann, but then they disappear below the surface. However, during the monsoon season (July-October) and for a few months thereafter the flood waters of these rivers combine with the waters blown up from the sea by the strong winds from the south-west. Much of the Little Rann, which is only a foot or two above mean sea-level, then becomes flooded and forms somewhat of an estuary to the Arabian Sea. Although parts of the Rann are never completely dry, by November or December extensive areas have a caked and salty crust upon which vehicles can safely travel until the monsoon again commences. The flat, cracked surface actually provides a 'super highway' during most of the dry season upon which vehicles can smoothly and safely travel at high speeds, as long as the darker or softer patches are avoided.

## Vegetation

The wild asses habitually forage at night upon the 'bets' or the shores of the Little Rann. Then during the daytime they retire to the desert wastes. With the exception of the 'bets', there is no vegetation in the Rann because of the impregnation of salt and other compounds. The sparse vegetation of the 'bets' consists primarily of low scattered trees, mostly *babul* (*Acacia arabica*) and some grasses, such as *kharib* (*Aelurops villosus*). Staple grasses along the shores of the mainland include *thegado* (*Cyperus capillaris*), *dabhado* (*Eragrostis cynosuroides*), *zinzvo* or *jinjro* (*Andropogon* spp.) and *chaktadun* (*Eragrostis amabilis*). Nearby cultivations also contribute to the diet of the asses during the crop season. According to Gee (1962) they raid, in order of preference, the following crops: gram, wheat, cotton, millet, and *jowar*. These crop depredations may be influenced by the apparent lack of other

suitable forage. Nevertheless, all of the asses which I observed were robust and appeared to be in good condition—a marked contrast to emaciated domestic animals in the same areas.

A wealthy land owner living in Ahmedabad, but with extensive holdings near Kharaghoda and Patadi, petitioned the Government in the spring of 1966 to reduce the number of wild asses because of crop depredations. However, Forest Department personnel reported that when the local Divisional Forest Officer met this man and explained the importance and need for protecting this unique species, he withdrew his petition.

The planting of mesquite (*Prosopis juliflora*), locally called *vilayatibaval*, was initiated along the fringes of the Little Rann in 1954. These trees were originally introduced from Mexico, although some seed stock has also been obtained from the south-western United States. Seedlings are being planted along the shores of the Rann primarily to prevent the spread of the desert, but also to improve the soil fertility and to provide a wind-break and firewood.

Small trenches about three feet long, a foot or two wide and about a foot deep are dug at 15-foot intervals in selected sites during the dry season. Seedlings are then planted at the start of the rainy season. Some plantings do not take, particularly in areas that become flooded during the monsoon. However, the majority of the trees grow quite rapidly and many exceed 20 feet in height in about 10 years. Although domestic and wild ungulates, with the exception of goats, rarely feed upon the mesquite bushes or trees, the dry seed pods appear to be relished. As a result, seeds disseminated through the animal's droppings have planted additional areas, which in some cases are relatively distant from the plantation sites. The Forest Department has planted an average of about 2,000 acres per year since the initiation of the programme. Thus, the total area of mesquite plantations along the edge of the Little Rann now exceeds 22,000 acres.

**Fauna**

In so far as wild life is concerned, the Indian Wild Ass is the predominant species in the vicinity of the Little Rann. Blackbuck, chinkara and nilgai were formerly abundant along the shores of the mainland. Sálim Ali observed some blackbuck during his 1946 expedition, but claimed even then that they had been all but exterminated in many parts of the Rann and Gujarat where they were abundant only a few years previously. In 1962, E. P. Gee observed only a single 'frightened' blackbuck in the vicinity of Zilanand Bet and two or three nilgai on the mainland. We observed no blackbuck, but saw two chinkara and four nilgai in the Rann north-west of Tikar. However, we witnessed the ruthless gunning down of one of these by some 'sportsmen' in a jeep

and had the unpleasant task of apprehending the culprits. Except for wild asses, no other wild mammals were observed within the vicinity of the Little Rann.

Domestic livestock numbers, on the other hand, are excessive along the fringes of the Rann. Large herds of cattle were frequently encountered, as well as flocks of sheep, goats, and donkeys. With very few exceptions, all the areas which we visited were severely overgrazed. A lack of forage was already evidenced by the condition of most of the animals and it was difficult to imagine what would sustain them during the next six months until the monsoon rains. Mesquite appeared to be the only plant species relatively unaffected by the abuse of too much domestic livestock.

I am certain that if livestock numbers were properly controlled along the Little Rann the natural vegetation would better provide the benefits expected from the mesquite plantations. Although the cost of these plantings was formerly Rs. 56 per acre, the cost is now about Rs. 100 per acre or a total of approximately Rs. 200,000 per year. However, until livestock numbers can be brought under control, I feel the Forest Department is wise in continuing their present plantation programme. It was also explained that a few years ago about 200 acres of Eucalyptus was experimentally planted west of Dhrangadhra. Livestock grazing was excluded from the plantation in order to permit the seedlings to take hold. However, the local villagers rebelled against this infringement upon their 'rights' and during a single night they drove all of their livestock through the area. What seedlings were not destroyed by their livestock were then pulled up by hand.

Bird species within the vicinity of the Rann observed during our visit appeared to be restricted to a relatively few species. Several eagles and the omnipresent vultures were observed. By far the most common birds were small larks, which were encountered in flocks of 50 to 100 or more. Demoiselle cranes were frequently seen along the mainland and an occasional pair of sarus cranes. Flamingos were also observed flying overhead, but none were observed to light. North of Tikar, however, thousands of flamingo tracks were evident on a mud flat within the Little Rann.

## The Indian Wild Ass

### Description

The Indian Wild Ass or Onager somewhat resembles a zebra in build. The ears are relatively short, particularly in comparison to those of a donkey or mule. The neck appears to be on the thin side as compared to the stockiness of the rest of the body. The short mane remains erect and the dark medio-dorsal stripe that extends to the base of the tail

often gives the appearance of a continuous mane along the entire back. The tail is not thickly haired and, excluding the brush or tuft of coarse hair at the end, extends only to the hocks.

Specimens measured by Sâlim Ali (1946b) indicated that the normal adult head and body length slightly exceeds seven feet, the tail is approximately one foot long, the ear-length is 7-8 inches and the average shoulder height is just over four feet. The adult males which he collected weighed just over 500 lb. and females about 450 lb. Dharmakumarsinhji (1959), however, stated that females are usually 'stouter' than males. I found that these animals are extremely difficult to sex in the field. They rarely allow one to approach closer than several hundred yards and the testes of the males ascend into the body cavity when they are running. However, most of the animals which I distinguished as males appeared to be somewhat larger than the females. Once we spotted a solitary ass sprawled out in the desert, which appeared to have recently died. While approaching I thought, 'At last I'll have the opportunity to examine closely a wild ass.' I even had my tape out to take measurements, but when we came within 20 feet of the animal, it staggered to its feet and ran off. It had only been sleeping.

The coloration of the Indian Wild Ass is particularly striking. The tips of the ears and the tail, as well as the short mane and medio-dorsal stripe are dark amber brown to almost a brownish-black. The face and jaws, the top half of the neck, fore part of the shoulders, the saddle and sides of the rump (posterior to the flanks) are a bright reddish buff to fawn—almost a palamino colour. The muzzle, throat, lower half of the neck, most of the tail, and the underparts are white.

The bright coloration, larger and stockier build and the more stately manner immediately set the Indian Wild Ass apart from its long-eared and dingy grey or brown-coloured domestic relatives. There is little resemblance to the much smaller domestic donkeys common throughout northern India. While it may sound absurd to some or perhaps trite to others, about the best description that I can give of the Indian Wild Ass is that it is a beautiful and magnificent beast.

In contrast to the local domestic donkeys, which breed during any season of the year, the wild ass is reported to mate from August through October. It is claimed that during this time the males fight viciously for the females. The gestation period is roughly 11 months. Thus, the young are born from July through September. With the exception of one small male that was less than a month old, the foals which I observed during the latter part of December were of uniform size and appeared to be about 3½ to 4½ months old. If correct, this would mean that they were born in August or September, which would have been during the latter part of the normal foaling season.

### Group Size

Sálim Ali reported that the sexes live apart in separate herds or troops until the foals are about three months old. Although I observed some males with females and young, a few smaller groups appeared to be all males. Not including two solitary males nor a solitary female with her young foal, the average size for 14 troops totalling 186 asses was just over 13 (3-31). The average size for seven troops with young was 19 or an average of 15 adults + 4 young. These latter figures approximate the 6-8 young per group of 20-30 as observed by Sálim Ali in March 1946. But my overall totals indicate a ratio of less than one foal for every five adults. Group sizes observed are presented in Table 2.

TABLE 2

INDIAN WILD ASSES OBSERVED IN THE LITTLE RANN OF KUTCH IN DECEMBER 1966

| | Adults | Young | Total |
|---|---|---|---|
| December 20 (Jesda to Kharaghoda) .. | 22 | 8 | 30 |
| | 4 | — | 4 |
| | 26 | 5 | 31 |
| | 1 | 1 (less 1 mo.) | 2 |
| | 8 | — | 8 |
| | 18 | 4 | 22 |
| | 1 (male) | — | 1 |
| | 13 | 2 | 15 |
| | 7 | — | 7 |
| December 21 (Tikar to Khuda) .. | 7 | 4 | 11 |
| | 10 | 2 | 12 |
| | 1 (male) | — | 1 |
| | 9 | 4 | 13 |
| | 3 | — | 3 |
| | 5 | — | 5 |
| | 11 | — | 11 |
| | 14 | — | 14 |
| Total .. | 160 | 30 | 190 |

### Populations

The total Indian Wild Ass population for the Little Rann was estimated by Sálim Ali in 1946 to be between 3,000 and 5,000. He also believed their numbers were 'increasing year by year.' Wynter-Blyth estimated a total population of about 4,000 in 1956 and claimed that groups were then 'always in sight' once one entered the Little Rann north of Dhrangadhra. He also reported that some herds numbered over 200 head. The numbers of wild asses had apparently been decimated by disease prior to E. P. Gee's survey in 1962. He estimated a total of only 860-870 in the Little Rann proper plus 10 along the border of West Pakistan and the Great Rann.

Regretfully, neither time nor facilities permitted me to undertake a full-scale census or survey of the present status of the wild ass. However,

intensive counts or transects from Tikar to Kharaghoda resulted in counts almost exactly the same as those reported by Gee. The wild asses feed at night on the fringes or near-by croplands of the Little Rann. They then retreat into the Rann during the day, which enables one both readily and accurately to census them. Therefore, I am inclined to believe that the present status of the Indian Wild Ass is similar to what was reported in 1962.

There is the possibility that the number of wild asses has been slightly reduced during the last four years. The Range Forest Officer at Halvan claimed that in recent years there have been no wild asses in the vicinity of Khakhrechi. Gee reported 20 for that area. We were not allowed to enter the area west of Tikar because of military restrictions. Kesmari Bet and the adjacent parts of the Little Rann are used by the military as a firing range. However, the Forester stationed at Tikar reported that only occasional troops of asses are seen there. Gee reported approximately 100 for that area.

**Disease**

The Forest Guard in charge of mesquite plantings along the southern boundary of the Little Rann claimed that there was an epidemic among the wild asses in October and November of 1964. Also, he claimed to have seen about 100 dead asses between Jesda and Malvan and that most of these were 'old' animals. Since then he has not observed any more dead asses while supervising plantation operations in that area. The Forester at Tikar likewise reported that there was an epidemic of African Horse Sickness among the domestic horses in that area during October and November 1964. He stated that 'hundreds' of horses died in the vicinity of Tikar at that time, but he did not observe any dead wild asses.

I met the Veterinary Officer at Dhrangadhra, Dr. S. H. Kamboya, the evening of December 21. Dr. Kamboya claimed that the last major epidemic of African Horse Sickness in the Surendranagar District, which includes Thaluka and Dhrangadhra, was in November 1963. About 300 horses in the District were reported to have died as a result of this epidemic. But there were no official reports of deaths among wild asses, nor were the domestic asses or donkeys affected to any appreciable extent. Although Dr. Kamboya was posted to Dhrangadhra in 1965, he was formerly stationed in the District at Siyla, about 40 miles from Dhrangadhra.

Dr. Kamboya further stated that the horses in the District have been vaccinated against African Horse Sickness between October and November each year since 1961. Although this programme is operated at Government expense, some owners will not allow their horses to be injected. Vaccinated animals should be allowed to rest for 8 to 14 days after the injection and some owners claim they cannot afford to

have their animals idle for such a long time. It was also claimed that surra had not been observed in recent years in the Surendranagar District. However, there were authenticated reports in 1958 and 1960 of deaths of both horses and wild asses from this disease.

Rinderpest is present among the cattle of the district and a vaccinating programme is in operation. There was also a single case of anthrax reported in 1963. Rinderpest and anthrax probably have little effect upon the wild ass, but may be of importance in so far as other wild life in the vicinity of the Little Rann is concerned. Coupled with poaching and habitat destruction, disease may be the 'coup de grace' for species such as blackbuck, chinkara and nilgai.

**Human Influence**

The majority of the villagers living in the vicinity of the Little Rann are strict vegetarians and appear to have a high regard for animal life. With the exception of driving the wild asses from their cultivations during their night-time raids, it is doubtful that these people ever molest the asses.

There are scattered villages of crude shelters located within the Rann during the dry season. These are inhabited by people operating salt wells under lease from the Revenue Department. They dig large open wells from 10 to 15 feet in diameter and from 30 to 40 feet deep. The saline waters are then drawn up in skin bags by teams of bullocks. The water is run into pans and after evaporation the crystalline minerals are taken by lorry or bullock cart to collecting points, such as Khuda or Kharaghoda. Considerable revenue is realized by the government from these salt works and from taxes levied on the minerals collected.

A railroad from Ahmedabad to Kandla, a distance of approximately 180 miles, is presently being constructed primarily to further exploit this mineral resource. The railroad right-of-way passes through some of the areas frequented by wild asses. Whether or not this disturbance will have an adverse effect upon the ass populations remains to be seen. Also, it is not known whether or not the salt workers in the Rann molest the wild asses. However, their donkeys, horses and perhaps bullocks are a potential source of disease. Therefore, it would be desirable that the salt workings at least be restricted to certain specified sites, rather than allowed to cover extensive areas throughout the Rann.

There is apparently no poaching of wild asses, although Sálim Ali (1946b) found their meat quite agreeable. Likewise, there appear to be no natural predators that presently prey upon the asses. A number of people in Dhrangadhra told us of how they occasionally chase the wild asses in vehicles just to watch them run. Except during the foaling season and unless carried to excess, this probably does little harm. However, a 'trigger-happy' shooter in a jeep could easily decimate a

major part of the present population in a one-or two-day period. Measures should be taken to insure that this does not occur and that the Indian Wild Ass is protected and preserved.

### Discussion and Recommendations

The responsibility of protecting and preserving the wild ass and other wild life species in the vicinity of the Little Rann rests primarily with the State Forest Department. The chief danger to the wild ass at present appears to be their susceptibility to diseases contracted from domestic livestock. Therefore, all possible precautions should be taken to eliminate and prevent the incidence of disease among domestic animals. The present policy of annually vaccinating horses against African Horse Sickness during the epidemic season should be continued and also more strictly enforced. Owners who do not permit their horses to be injected should be penalised. A systematic method of reporting outbreaks of disease among wild asses, as well as domestic horses and donkeys, should likewise be initiated.

Overgrazing and human disturbances adversely affect the wild asses and other wild life. Measures should be taken to halt the all too common trend throughout most of India of ever-increasing numbers of useless domestic livestock. When I asked a local veterinarian if my estimate that 50 per cent of the livestock in the vicinity of the Little Rann was useless, he stated that my estimate was too conservative. He was positive that no more than 25 per cent (of the cattle) in this area were useful and that the remaining 75 per cent were completely worthless. People should be educated as to the importance and value of natural resources, such as wild life. Luckily, most of the villagers near the Rann are in sympathy with the wild ass. It is regretful that more of the general public are not of the same disposition in so far as wild life is concerned.

Poaching is undoubtedly a major factor in the disappearance of such wild life species as blackbuck and chinkara, which formerly inhabited the vicinity of the Little Rann in abundance. Such small numbers of these animals now exist that there is no reason why shooting cannot be strictly prohibited throughout the entire area. The military, specifically those in charge of the establishment near Tikar, should be contacted and their aid enlisted in the protection of wild life. The public should also be made aware of laws which afford wild life protection and of the penalties involved if these laws are violated. A system of rewards for information leading to the arrest of law-breakers should encourage the assistance of the local people.

Little is known about the basic ecology of the Indian Wild Ass and qualified personnel should be encouraged to study this unique and magnificent beast. Although the Indian Wild Ass could be easily and

accurately censused, its present numbers or true status is not even known. A census should be conducted every year, or at least every two years. If well planned, this could probably be accomplished in less than a week by jeep. There is also the possibility that an accurate aerial census could be conducted over the entire Rann in a matter of a few hours. These figures would be invaluable in assessing the status and trends of the wild ass populations, as well as indicating measures which may be of value in preserving this species.

The Junagadh Zoo has two adult male wild asses. In addition, two young wild asses were captured by the Forest Department in the fall of 1966 for this zoo. Unfortunately, both were males and one died within a few weeks. Mr. Gee reported that the Ahmedabad Zoo had three head in 1962. However, it appears that there are no other zoos in the world (with the exception of the Maharaja of Baroda's zoo) with a breeding pair of Indian Wild Asses, although Gee (1962) reported that they were successfully bred in Paris in the mid-1800's. Young wild asses are easily captured and are reported to become tame within a relatively short time. There is no reason why several pairs of young asses should not be captured, under the supervision of the Chief Conservator of Forests who is also the State Wild Life Preservation Officer, and breeding groups established in some of the reputable zoos in India. These would also provide a reserve in case something happened to the wild populations.

Finally, as has been advocated by the Chief Conservator of Forests and other members of the Forest Department, an inviolate sanctuary for the Indian Wild Ass should be established. This sanctuary would also provide refuge for other forms of wild life. It should include a sufficiently large area of both the Little Rann and the adjoining mainland so as to constitute an ecological unit. One or more sources of perennial water should be included and, if at all possible, domestic livestock and human disturbances, such as salt works and agriculture, should be completely excluded. Sufficient forage would then be probably available within the sanctuary to help deter the wild asses from making forays into the surrounding crop lands. Initially it should also be realized that the isolated location of the Little Rann would prevent the wild ass sanctuary from becoming a major tourist attraction in the forseeable future. Nevertheless, this is no excuse for not establishing and maintaining a sanctuary for the preservation of the wild ass.

If the wild asses and the presently available accommodations in Dhrangadhra were publicised, some tourists would undoubtedly come primarily for the sake of seeing these animals in their unique habitat—the Little Rann. Facilities presently available consist of a Public Works Department Rest House in Dhrangadhra, which can accommodate a party of up to six people and which provides complete services, including

a cook. The Dhrangadhra Chemical Works also has a first class guest house adjoining the Indian Ornithological Garden. Although privately owned, perhaps prior arrangements could be made by tourists desiring to see both the Garden and the wild asses.

I was informed after leaving Gujarat that the construction of a dam across the entrance to the Little Rann has been proposed. Some people apparently feel that if the waters of the Arabian Sea were excluded from the Rann during the monsoon season, perhaps some of the Rann could eventually be devoted to agriculture. This possibility seems improbable because of the high mineral content of the soil throughout the Rann. Perhaps by using tremendous quantities of water to flush these minerals from the soil some areas could be made suitable for crops. However, no such source of water exists in the vicinity of the Little Rann. On the other hand, the construction of such a dam probably would change the entire ecology of the Rann and the results may prove disastrous. Not only may the wild asses be affected, but existing agriculture, salt works, and so forth also may be adversely affected. In general, it is wise not to tamper with the ecological balance of nature until thorough scientific investigations have been made.

In summary, I make the following recommendations :

1. That domestic livestock grazing in the vicinity of the Little Rann be brought under control and scientifically managed, particularly on the Forest Department lands.

2. That the Government programme of inoculating horses for African Horse Sickness be continued and that a systematic method of reporting outbreaks of disease among both wild and domestic animals be initiated.

3. That all shooting within the vicinity of the Little Rann be prohibited. Firing on the military range near Tikar would, of course, be an exception.

4. That the wild asses be regularly censused and that observations concerning them and their populations be kept on file with the Forest Department.

5. That competent people be encouraged to conduct thorough ecological studies of both the wild ass and the Little Rann as soon as possible.

6. That young wild asses be humanely captured and breeding groups established in reputable zoos in India.

7. That a sufficiently large part of the Rann and the adjoining mainland be constituted as an inviolate wild life sanctuary, primarily for the preservation of the Indian Wild Ass.

8. That projects which may upset the ecological balance of the Little Rann may not be undertaken until it has been definitely established that their benefits would outweigh their possible deleterious effects.

## IV. THE GREAT INDIAN BUSTARD

### Introduction

There are 22 species of bustards occurring in Africa, Europe, Asia and Australia. The Great Indian Bustard is one of the largest and most stately of these. Formerly it was found locally from West Pakistan throughout the Indian Union (excepting Bengal and Assam) south to Mysore. However, this magnificent bird has become very rare and now is restricted to a few secluded areas in Gujarat and neighbouring states. In all cases it is extremely rare and it is only with a great deal of luck or perseverance that it may be encountered.

The Indian Board for Wild Life placed the Great Indian Bustard upon its list of rare faunal species[1] and gave it full protection in 1952 because of its increasing rarity. Nevertheless since that time definitive measures have not been taken to preserve or to protect this endangered species. In contrast, I have been told that when Dhrangadhra was a princely state a fine of Rs. 1,000 and/or imprisonment for a period of up to six years was levied against anyone found killing this royal bird. The Great Indian Bustard is an endemic species. In other words, it is found only in India and in no other country. Therefore it is the duty of the State and Central Governments of India, as well as the Indian people, to preserve the remnants of this great bird as a part of their nation's heritage.

### The Great Indian Bustard

The Great Indian Bustard is a large, turkey-sized bird weighing up to 40 lbs. It stands about three feet high. The sexes are alike. They have a distinctive black crest on the head and black and white markings on the breast and underparts. A large whitish patch near the tip of the wings is also prominent. The back and upper surface of the wings are buff, finely vermiculated with black. It is a heavy ground bird and is usually encountered alone or in pairs, although small groups numbering up to 25 or 30 birds were reported in former days. The cock is polygamous and to ' woo ' his harem he does a puffed-up strutting display, similar to many of the grouse.

The habitat of the Great Indian Bustard has been drastically reduced in recent years due to the spread of cultivation. This has continued unabated even though its former haunts are generally considered as sub-

[1] Other faunal forms in India which are included on the Indian Board for Wild Life's list of endangered species are: Indian wild ass, Indian lion, snow leopard, clouded leopard, cheetah (probably extinct), Indian one-horned rhinoceros, Kashmir Stag, musk deer, brow-antlered deer, pygmy hog, pinkheaded duck (undoubtedly extinct) and the whitewinged wood duck.

marginal agricultural lands. In addition to habitat destruction, characteristics which have further added to its decline include: it is considered as a gourmet's delicacy and all too many people who are acquainted with this great bird are primarily interested in collecting it for the table. Its large size makes it relatively conspicuous in its preferred grassland habitat. Its size and conspicuousness coupled with its heaviness in initial flight also make it exceptionally vulnerable to the gun. It is, however, a good runner. Finally, the female generally lays but a single egg. Even if the singleton does survive, it does not attain breeding age in the case of a hen until about four years old. In the case of a cock, it does not mature until 5 or 6 years of age.

We were informed by S. P. Patel, a photographer in Dhrangadhra, the evening of December 21 that a farmer had reported seeing a pair of Indian bustard on his land about 8 miles south-west of Dhrangadhra. Therefore we decided to attempt to locate these rare birds. The following morning the farmer accompanied us (Messrs. Patel, Karnik, two of the local Forest Staff and myself) to the site where the bustard had been seen a few days previously. Although we spent the better part of the day combing the entire area, the only trace of bustard that we encountered were a few tracks of a solitary bird that had apparently visited a waterhole the previous night. This was in an area in which K. S. Dharmakumarsinhji claims it used to be possible to see dozens of bustard in a single day's search. Incidentally, besides being a noted wild life enthusiast and conservationist, Shri Dharmakumarsinhji is also undoubtedly the world's leading authority on the Great Indian Bustard. At a previous meeting in New Delhi he had expressed to me his grave concern about the precarious situation of the bustard. Also he is one of the few persons who has ever photographed the Indian bustard on its nest or for that matter who has even been successful in photographing this rare bird in recent years.

The terrain in the vicinity of Dhrangadhra consists of low undulating rocky hills. Small patches of short grass are intermingled with rocky outcroppings and scattered bushes or thorny shrubs. Small patches of cultivation are usually located wherever the soil is not too rocky. Dry season crops of wheat or cotton are grown on most of these. Many patches were still in cotton during my visit in December, but the patches of wheat had been harvested earlier in the season and had been or were being ploughed. Although it was claimed that the rains had been exceptionally heavy this year and that this was a much better than usual crop season, the cotton in most cases appeared to be very poor. Few of the cotton plants exceeded two feet in height and many were under a foot tall.

We encountered people, bullock carts and livestock wherever we went. Some of the people were tending their cultivations or livestock, but many

were cutting and collecting thorny shrubs, such as *Zizyphus mauritiana* and *Acacia leucophloea*. These bushes are used to construct corrals and livestock fences around the villages. What little cover that remains for wild life is disappearing rapidly. Perhaps equally disconcerting were the numerous jeep tracks which we encountered almost everywhere.

According to authoritative descriptions, the areas visited were formerly prime Indian bustard habitat. They should harbour a fair number of birds even now. However, with the ever-present and excessive human disturbances it is doubtful that few, if any, larger forms of wild life will be able to survive long. The only wild mammals observed during our excursion were four extremely wary nilgai (a male, 2 females and a yearling) and a solitary hare. We made inquiries of many of the villagers whom we encountered concerning bustard and other animals. Most did not even know what a Great Indian Bustard looked like. The few that did were those who remembered them from the olden days. They usually wanted to know if we were interested in shooting this big bird. When we explained that we were not, they appeared unable to comprehend why we were then so interested in this bird. Many villagers, however, told us of how 'sportsmen' and military personnel often came here in jeeps to shoot. One farmer and his son explained that they saw some 'sportsmen' in a jeep a few days previous shoot a large black and white bird that was 'sleeping' on the ground. In the afternoon we finally considered the search for bustard as futile and returned to Dhrangadhra.

No bird species has reportedly become extinct since 1945. However, unless decisive action is soon taken, the Great Indian Bustard may soon be added to that all too long list of faunal forms that have succumbed to the depredations of man.

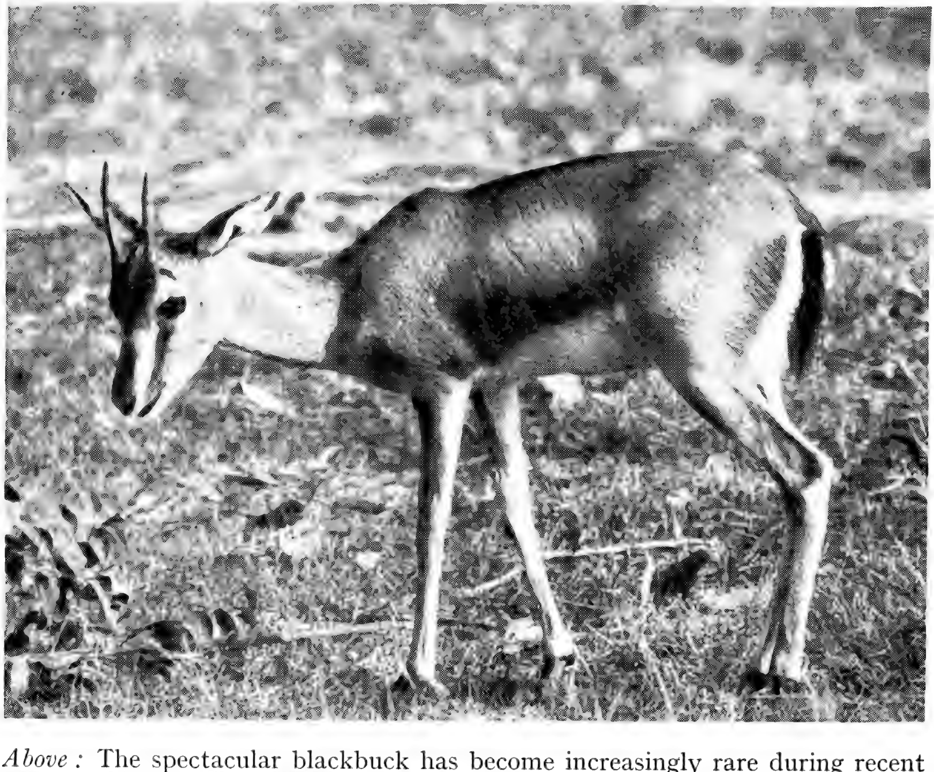
## V. NAL SAROVAR

Almost at the junction of the mainland of Gujarat and Saurashtra or the Kathiawar Peninsula lies an extensive flood plain. This flat plain was formed by silt carried down from the Chotila Ranges of the Surendranagar District by the Baman, Bhogavo and other rivers. Because of annual flooding there is little natural vegetation, but the rich clay-loam soils on many of the flats are utilized during the dry season for growing winter crops, such as cotton and wheat.

A vast shallow lake is formed during the monsoon season. This lake is located about 40 miles south-west of the city of Ahmedabad, along the eastern boundary of the Surendranagar District and the western boundary of the Ahmedabad District. The excess waters from the Nal Sarovar Reservoir then drain into the Sabarmati, after passing through the Bhal area of Dholka-Dhandhuka. The water surface of the flooded

Flamingos and Common Coots at Nal Sarovar, 40 miles south-west of Ahmedabad in Gujarat State.

(*Photo* : *S. P. Patel*)



*Above* : The spectacular blackbuck has become increasingly rare during recent years throughout Gujarat State ; *Below* : The chinkara is becoming rare throughout its range in India.

(*Photos : Author*)

area often exceeds 100 square miles during the peak flood season in July or August. The lake is then 5 to 6 miles wide and from 18 to 25 miles long. However, by December (the migratory bird season) it usually is reduced to a total area of less than 80 square miles. Although much of the lake is surrounded by barren shores or flats, along the higher fringes are scattered trees, such as *Salvadora* sp. and *Prosopis* sp., and desert scrub.

The primary attraction of Nal Sarovar is its vast concentrations of water birds. Particularly of note are the migratory species that arrive from the north during late November or early December and usually remain until late March. Included among the more conspicuous water birds that may be observed are: flamingoes, spottedbilled or grey pelicans, whitenecked and blacknecked storks, white and painted storks, sarus, common, and demoiselle cranes, spoonbills, black and glossy ibis, herons, coots, moorhens and numerous species of waterfowl. Predatory or carrion eating birds such as eagles, vultures and kites are also present, as well as numerous lesser species, such as kingfishers, lapwings, babblers, bulbuls, barbets, sunbirds, tailor birds and so forth.

Nal Sarovar is readily accessible throughout the year, although December through March is the best time for observing migratory birds. A good black-topped road from Ahmedabad passes near the lake and daily bus service is available. Facilities include a tourist hut near the lake and a boat. Reservations may be obtained from the Director of Information for Gujarat at Sachivalaya, Ahmedabad-15.

It was recently proposed that Nal Sarovar be constituted as a bird sanctuary. Also, that facilities be developed so that it may become a major tourist attraction. It is to be hoped that these proposals will be fully realized in the near future.

## VI. Acknowledgements

Special thanks go to Mr. R. D. Joshi (Chief Conservator of Forests) and the Forest Department of Gujarat for their courteous assistance and kind hospitality during my visits to the Gir Wild Life Sanctuary and the Little Rann of Kutch. Particularly I wish to thank Messrs. P. B. Vyas (Sanctuary Superintendent), J. Singh (Sanctuary Inspector), and G. R. Karnik (Rajkot Divisional Forest Officer). Messrs. Vyas and Singh accompanied and assisted me during my 5-day visit to the Gir Wild Life Sanctuary. Mr. Karnik then accompanied and assisted me during the 5-day period in which we visited the Little Rann of Kutch. Other Forest Department personnel, too numerous to mention individually, were likewise most helpful and their assistance is greatly appreciated.

I am also grateful to Messrs. G. C. Jain (Manager of the Dhrangadhra Chemical Works), Kumar (Public Relations Officer) and P. Kannan (Honorary Director of the Indian Ornithological Gardens) for their hospitality during our stay in Dhrangadhra.

Finally, I must express my heartfelt appreciation to Mr. E. P. Gee of the Indian Board for Wild Life for making the necessary arrangements with both the Central and State Governments and for his always welcomed assistance. The company of both he and his sister, Mrs. Romanes, during our visit to the Gir was most enjoyable.

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(*to be continued*)

# *Heteromysis zeylanica* Tattersall (Crustacea : Mysidacea), an associate of Madreporarian Corals in South Indian Waters

BY

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(*With twenty-six text-figures*)

Mysids are predominantly free living marine animals more abundant in comparatively shallow water. No species has so far been recorded as a parasite. However, as early as 1879, Hilgendorf recorded *Heteromysis harpax* as an associate of hermit crabs inhabiting gastropod shells. Nothing was known about the nature of this association until Clarke (1955) published very interesting observations on the association between *H. actineae* and the sea-anemone *Bartholomea annulata.* Since then O. S. Tattersall (1962) reported *H. harpax* as an associate of hermit crabs of the genus *Dardanus*, *H. gymnura* from the arms of an ophiuroid and *H. zeylanica* from a sponge.

While washing corals for collecting their copepod associates my colleague Sri M. J. Sebastian obtained a number of specimens of *H. zeylanica* W. M. Tattersall (1922). This probably indicates that a majority of the species of *Heteromysis* live in association with invertebrates. I, therefore, give below a short résumé of the available information on the genus *Heteromysis* as it may help those who take up the study of the ecology of these mysids. A detailed study of the specimens collected has shown that a few interesting features in the morphology of *H. zeylanica* have so far escaped notice, therefore the species is redescribed.

## HISTORY OF THE GENUS *Heteromysis*

The genus *Heteromysis* was created by S. I. Smith (1873) to describe *H. formosa* collected from the coastal waters of North America. Subsequently this species was recorded from several localities in European waters. G. O. Sars (1877) created the genus *Chiromysis* to describe

*C. microps* collected from the coastal waters of Africa. To the latter genus Hilgendorf (1879) added a second species *C. harpax*. Later on G. O. Sars (1885) described *H. bermudensis* collected from Bermuda and also admitted that his *Chiromysis* is a synonym of *Heteromysis*. Walker (1898) described *H. odontops* from North American waters and Holmes (1900) added another species, *H. spinosus*. The latter was, however, found to be synonymous with *H. odontops* Walker. Bonnier & Perez (1902) created the genus *Gnathomysis* to describe *G. gerlachei* collected from the Red Sea. They published a short description without figures. W. M. Tattersall (1922) examined the unpublished illustrations made by Bonnier and concluded that *G. gerlachei* is a synonym of *H. harpax* and that *Gnathomysis* Bonnier & Perez is the same as *Heteromysis* S. I. Smith.

The discovery of more species followed in quick succession. From the Gulf of Mannar, south India, W. M. Tattersall (1922) described *H. proxima*, *H. zeylanica* and *H. gymnura*. Verrill (1922) described *H. antillensis* from Dominica but this was later found to be a synonym of *H. bermudensis* G. O. Sars. While describing a collection of mysids from Australia W. M. Tattersall (1927b) added *H. waitei* and *H. tasmanica* and a third species *H. digitata* (W. M. Tattersall 1927a) from the Suez Canal. From subterranean salt water pools at Canary Islands, Calman (1932) described *H. cotti*. More recently Nouvel (1940) described *H. armoricana* and *H. tattersalli* (Nouvel 1942) from France and Cape Verde Islands respectively. From the Mediterranean Bacesco (1941) recorded *H. eideri* and Pillai (1961) described *H. macropsis* from south Indian waters. Clarke (1955) added a very interesting species *H. actineae* from Bahama Islands and O. S. Tattersall (1961) described *H. atlantidea* collected from African waters. Lastly Ii (1964) described *H. xanthops* from Japanese waters.

Recently Nouvel (1964) examined the original illustrations of *H. gerlachei* prepared by Bonnier and concluded, contrary to the opinion of W. M. Tattersall, that *H. harpax* Hilgendorf and *H. gerlachei* Bonnier & Perez are separate species and that *H. harpax* Kossmann (1880) is different from both. He renamed the latter as *H. kossmanni*. The genus *Heteromysis* thus includes twenty-one species.

*H. formosa* S. I. Smith, 1873
*H. microps* (G. O. Sars), 1877
*H. harpax* (Hilgendorf), 1879
*H. bermudensis* G. O. Sars, 1885
*H. odontops* Walker, 1898
*H. gerlachei* (Bonnier & Perez), 1902
*H. proxima* W. M. Tattersall, 1922
*H. zeylanica* W. M. Tattersall, 1922
*H. gymnura* W. M. Tattersall, 1922

*H. waitei* W. M. Tattersall, 1927
*H. tasmanica* W. M. Tattersall, 1927
*H. digitata* W. M. Tattersall, 1927
*H. cotti* Calman, 1932
*H. armoricana* Nouvel, 1940
*H. eideri* Bacesco, 1941
*H. tattersalli* Nouvel, 1942
*H. actineae* Clarke, 1955
*H. macropsis* Pillai, 1961
*H. atlantidea* O. S. Tattersall, 1961
*H. xanthops* Ii, 1964
*H. kossmanni* Nouvel, 1964

## Ecology of *Heteromysis* spp.

A surprising fact about species of *Heteromysis* is their comparative rarity. Most of the species have till recently been described only from a few specimens accidentally obtained during the course of routine collecting.

As early as 1879 it was known that *H. harpax* lives in association with hermit crabs inside gastropod shells. But that this association is obligatory at least for the mysid has been proved only very recently. Since Clarke (1955) published his observations on *H. actineae* evidence was obtained showing that at least two other species live in association with hermit crabs, one species with ophiuroids and one with sponges and corals. As observed by O. S. Tattersall (1962) 'it is now beginning to be apparent that the paucity of material may be due not to the rarity of the different species so much as to their cryptic mode of life'.

The available information on the ecology of the species has been summarised by Clarke (1955) and O. S. Tattersall (1962). According to Clarke *H. formosa* generally lives in small colonies within the empty shells of large bivalves and gastropods. This shows their natural tendency to seek suitable shelters.

Clarke observed *H. actineae* living in small colonies among the tentacles of the sea-anemone *Bartholomea annulata*. He made detailed observations both in the field and in the laboratory. The mysids spent most of their time coursing up and down the length of the tentacles of the anemone or spiralling around the base of the tentacles and never strayed away from the anemone. Clarke reported that the anemone was quite indifferent to the presence or absence of the mysids. Whenever food was given to the anemone the mysids were never found to take it. On the other hand every particle rejected by the anemone was at once seized and eaten. Clearly there is perfect understanding between the partners and this is a clear case of commensalism.

O. S. Tattersall (1962) reported the collection of *H. harpax* from

various species of pagurid crabs of the genus *Dardanus*. She observed that this 'is a true commensal with the hermit crabs, receiving protection from them and feeding upon their faeces, thereby keeping the innermost region of the shells they inhabit clean and free from waste matter.' O. S. Tattersall also reported the collection of *H. gymnura* from among the arms of a large brittle star, *Astroboa nigra* Doderlin.

*H. zeylanica* was first discovered as free living among the littoral sea weeds in the Gulf of Mannar. Later it was collected from the central cavity of a tubular sponge from African waters. During the present investigation it was found associated with two species of corals, *Favia* sp. and *Montipora* sp., being much more abundant on the latter. As I had no chance to study them alive nothing can be definitely stated about the nature of the association. However, the following conjecture may be made. Mysids generally feed by filtering fine particles of food from the water or eat large morsels by holding them with their legs. The massive third thoracic endopods indicate that *Heteromysis* belongs to the latter category. Coral polyps are very much like anemones in their method of feeding. Those with large tentacles are true predatory carnivores but others with small tentacles entangle the food in mucus and get them wafted towards the mouth by ciliary current. According to Hyman (1940) plankton constitutes their main item of food. The undigested part of the food taken in, collects in the centre of the coelenteron and is ejected out by convulsive contractions through the wide open mouth. It is possible that the mysids make use of the ejected particles and also get protection from the coral polyps just as in the case of *H. actineae*. By removing these particles the mysids assist the corals to remain clean. Accumulation of dirt has been known to cause the death of certain types of corals (Hyman 1940). This is also likely to be a case of true commensalism but direct observation is necessary for a definite conclusion.

An intriguing feature of the association between species of *Heteromysis* and other invertebrates is that in every case, except that of hermit crabs, the mysids were found in the company of caridean shrimps. Clarke found *Alpheus armatus* Rathbun, regularly associated with *H. actineae*. Bruce (*vide* O. S. Tattersall 1962) observed *H. gymnura* with *Periclimenes lanipes* Kemp and a wide variety of shrimps were associated with *H. zeylanica*. In the present case there were a large number of small pontoniid shrimps and alpheids. Clarke found no competition between the shrimps and the mysids. That the shrimps and mysids were always found together, irrespective of the kind of the host, is interesting. Identical ecological necessities might have brought them together initially. This must have later on developed into passive toleration or active cooperation. That a dangerous animal like the sea-anemone tolerates both is significant. Obviously the association is old and well established. This is thus a fertile field for detailed investigation.

## Heteromysis S. I. Smith

*Heteromysis* W. M. Tattersall, 1922, p. 495 ; Clarke, 1955, p. 7 ; O. S. Tattersall, 1962, p. 234.

The members of the genus *Heteromysis* can be easily distinguished by their short robust body, large eyes, oblong fully setose antennal scale and above all by the massive third thoracic endopods. The near absence of sexual dimorphism in the pleopods is also characteristic.

The four species hitherto known from Indian waters differ thus :—

1a. Peduncle of the eye with a dorsal process, proximal part of lateral border of telson with spines........................................*zeylanica*

1b. Peduncle of the eye without process, proximal part of lateral border of telson without spines..............................................2

2a. Antennal scale longer than antennal peduncle ; cornea wider than eye stalk ; endopod of uropod without spines..................*gymnura*

2b. Antennal scale not longer than antennal peduncle ; cornea narrower than eye stalk ; endopod of uropod with spines..............................3

3a. Endopod of uropod armed with a single spine at the region of the statocyst ; carpopropodus of third thoracic endopod massive......*proxima*

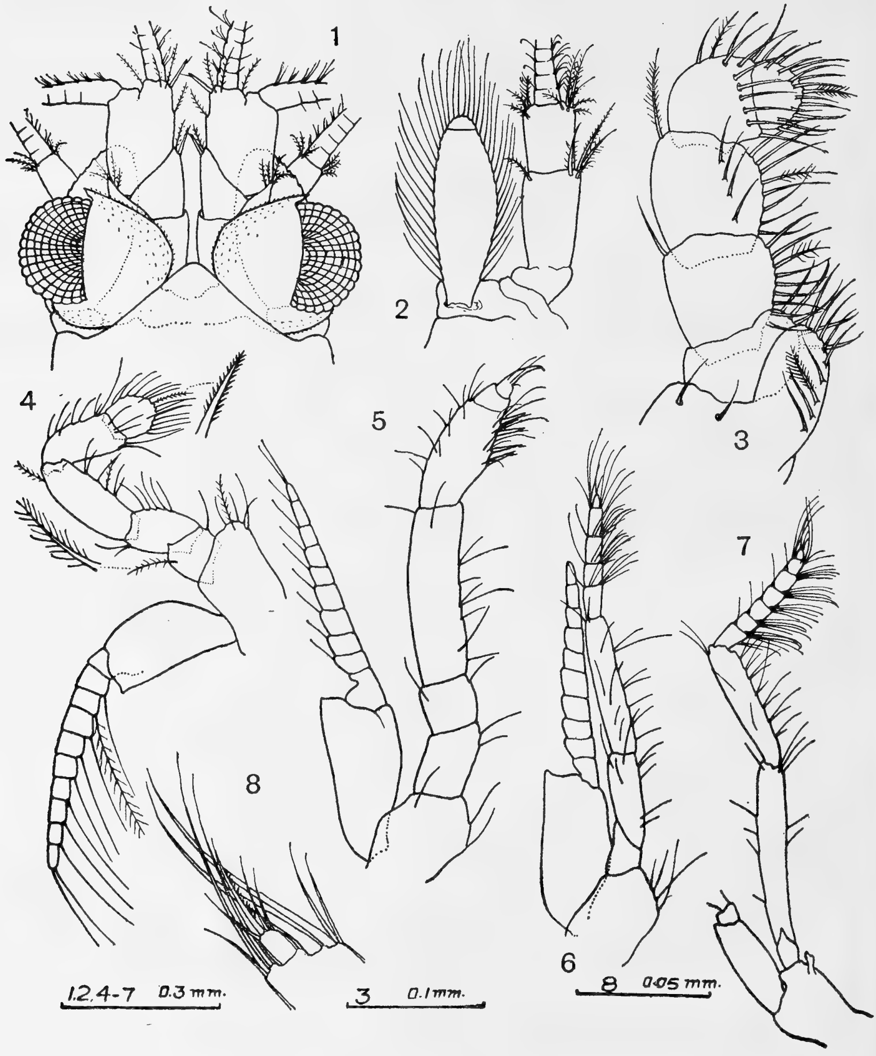
3b. Endopod of uropod armed with 8 spines ; carpopropodus of third thoracic endopod normally developed..................................*macropsis*

## Heteromysis zeylanica W. M. Tattersall

*Heteromysis zeylanica* W. M. Tattersall, 1922, p. 499, figs. 27a-e ; O. S. Tattersall, 1962, p. 246.

F e m a l e. Body is comparatively short with moderately stout cephalothorax and slender abdomen. Carapace has a narrow tolerably deep postero-median excavation and is anteriorly produced into a prominent triangular apically rounded rostrum (fig. 1) which reaches the middle of the basal segment of the antennular peduncle. Eyes are large with the cornea narrower than the peduncle. Below the cornea there is a small cluster of oscelli embedded inside the peduncle. The peduncle is spiny and dorso-distally produced into a sharp prominent spine-like process overlapping the cornea (fig. 1). The telson (fig. 9) is elongate-triangular, about one and a quarter times as long as broad, with a deep posterior sinus which is a third of the total length of the telson. The lateral borders of the telson are armed with fourteen pairs of spines, the first five pairs are nearly of the same size and are separated from the distal group of spines by a gap. The distal group of eight pairs of spines gradually increase in length towards the apex; the apex of each telsonic lobe is armed with two spines which are rather blunt; the outer apical spine is nearly one and a half times the length of the inner; the distance between the ultimate lateral spine and the outer apical spine is greater than the distance between any two of the lateral spines (fig. 9). The

apical sinus of the telson is proximally armed with thirteen small spines, six pairs and a median spine.



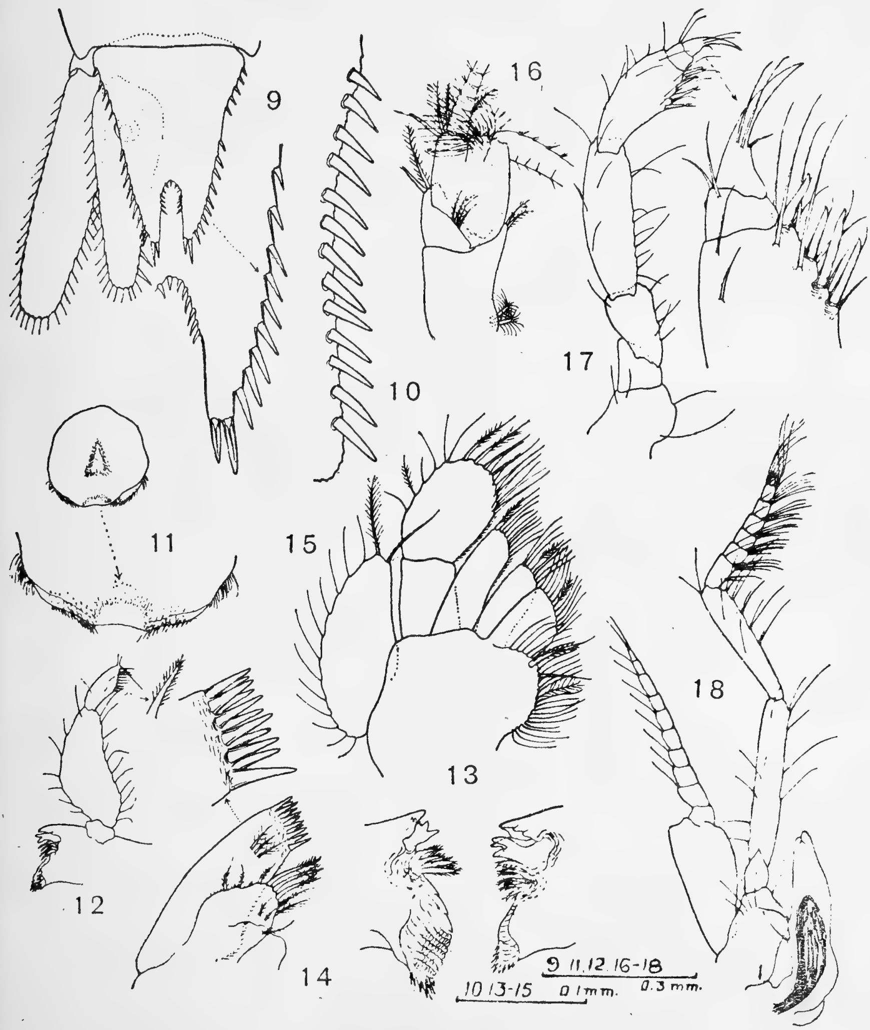

Text-Figs. 1-8. *Heteromysis zeylanica*. Female

1. Anterior part of body, dorsal view ; 2. Antenna ; 3. First thoracic endopod ; 4. Second thoracic leg ; 5. Third thoracic leg ; 6. Fourth thoracic leg ; 7. Eighth thoracic endopod ; 8. Same, tip enlarged.

The outer distal part of the first segment of the antennule is produced and carries three to four setae; second segment has a very oblique distal border and its inner distal part carries a triggered spine and a seta; inner border of the third segment has a median seta and a distal group of two setae and a triggered spine. The antennal scale (fig. 2) is rather narrow

and elongate-oblong, reaching slightly short of the tip of the antennal peduncle, it is setose all round and there is a distinct apical partition.

The upper lip (fig. 11) is irregularly circular and not anteriorly produced, its distal border is spiny. The mandibles (figs. 12-13) are asymmetrical and the palps are short but stout. Outer lobe of first maxilla (fig. 14) has three inner distal setae and about eleven strong distal spines in two rows. Inner lobe is small and ovate. Second maxilla (fig. 13) is of the usual pattern with the distal segment of endopod rather large.




Text-Figs. 9-18. *Heteromysis zeylanica*. 9-15. Female. 16-18. Male.

9. Telson and uropod ; 10. Inner border of endopod of uropod ; 11. Upper lip ; 12. Mandible ; 13. Same, cutting edge enlarged ; 14. First maxilla ; 15. Second maxilla ; 16. Antennule ; 17. Third thoracic endopod ; 18. Eighth thoracic leg.

First thoracic endopod is somewhat flattened and heavily armed with strong stiff setae (fig. 3); basal segment is produced into a large inner lobe; second segment has a small lobe; there is no distinct nail. Second thoracic endopod (fig. 4) is rather slender; basal segment is slightly produced at the inner distal part; sixth segment is rounded; there is no distinct nail. Third thoracic endopod (fig. 5) is only moderately stout; carpopropodus is shorter than the merus and the distal half of its inner border is armed with four triggered spines and a few setae; there is an indistinct partition near the distal end; dactylus is small and carries a slightly curved nail with three setae near its base. Carpopropodus of thoracic endopods four to eight is subdivided into several segments; fourth (fig. 6) has four subsegments and the others (fig. 7) six subsegments; the dactylus is very small and carries a styliform nail; the last carpopropodal segment carries very long characteristically curved setae (fig. 8). Thoracic legs seven and eight carry a pair of broad lamellae; the brood pouch generally carries four embryos.

Pleopods are simple flattened plates, first pleopod is very small and distally faintly bilobed, the remaining pleopods successively increase in length.

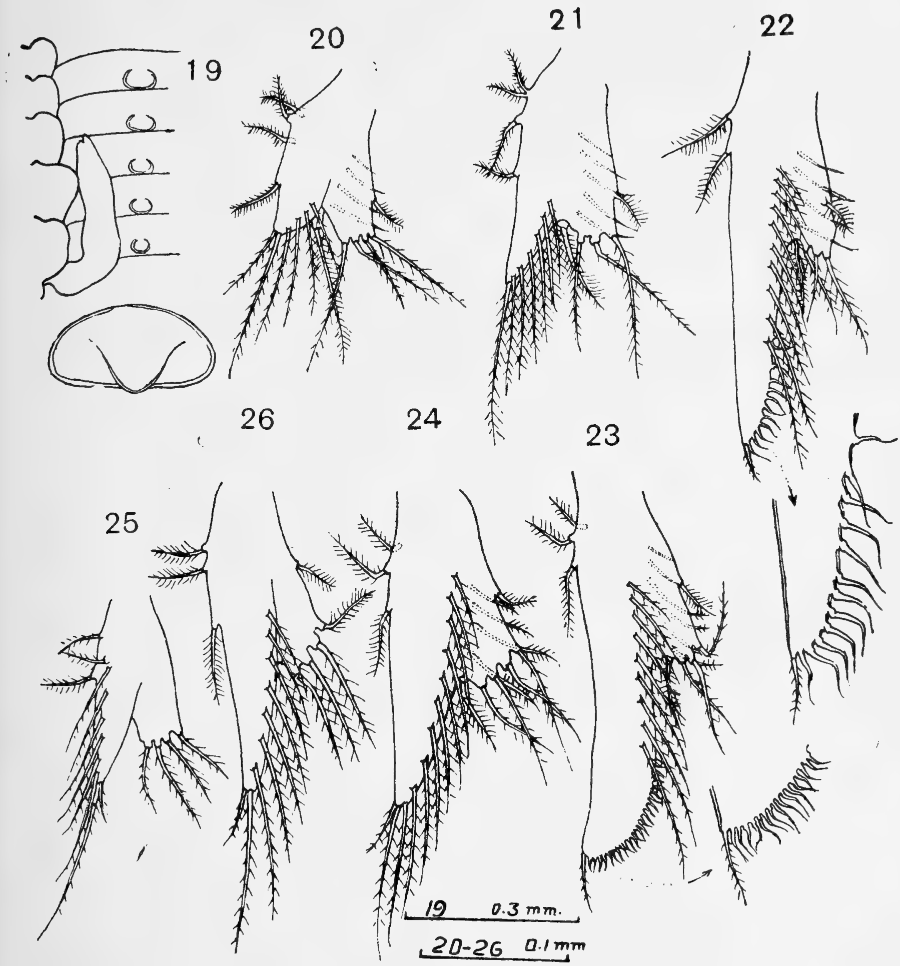
The rami of the uropods are setose all round; exopod is longer than the endopod; both rami over-reach the telson. Beginning at the region of the statocyst and extending up to the tip is a row of twelve moderately sharp spines on the inner border of the endopod, which regularly increase in length distally (fig. 10).

Length 5 mm.

Male. As usual in the genus the male is very much similar to the female in general appearance. However, the following characters serve to distinguish it. The rostral prolongation of the carapace is a trifle narrower and apically more acute than in the female. The third segment of the antennular peduncle (fig. 16) carries distally on the ventral side a small lobe carrying long stiff hairs. Third thoracic endopod (fig. 17) has its carpopropodus comparatively shorter but stouter than in the female and the spines arming the inner border are stronger. The nail is more strongly curved. The eighth thoracic endopod (fig. 18) carries a large appendix masculina which is apically trilobed. Thoracic segments four to eight carry transversely oblong sternal processes becoming successively smaller backwards, each process has in the middle a small spiny prominence (fig. 19).

It is generally assumed that the pleopods are similar in the two sexes, but Coifmann (1936) described some modification of the setae in *H. digitata* and *H. harpax*. Ii (1964) found the same to be the case in *H. xanthops* but did not describe or illustrate it. In *H. zeylanica* the modification is very pronounced and easily distinguishes the males from the females. The third male pleopod (fig. 22) is comparatively longer than

in the female. Its proximal half carries normal setae but the distal half has along its outer border about twelve short modified non plumose setae. Each modified seta has its distal part considerably thinned out




Text-Figs. 19-26. *Heteromysis zeylanica*. 19-24. Male. 25-26. Female.

19. Thoracic sterna five to eight showing sternal processes; 20-24. Pleopods one to five; 25. Pleopod two; 26. Pleopod five.

so that the setae appear like spines when examined under low magnification. The fourth pleopod (fig. 23) is still more modified. It is rather broad throughout (not conical as in the female) and near the tip is bent inwards, the modified setae arming the border are placed so close that the appendage appears to have a closely serrate border.

Length 4·8 mm.

Remarks. The original description of this species was based on two males and two immature specimens collected at Kilakarai, Gulf of Mannar, south India. They were collected from rock pools using a hand net. Subsequently O. S. Tattersall supplemented the short original description with some notes based on twenty specimens collected from a sponge at Zanzibar. The present study shows that this species is somewhat variable in its characters.

O. S. Tattersall observed sternal processes on the last three thoracic segments of immature females but none in the male. In my specimens adult males have these processes on the last five segments but none were observed in the female. In the type the endopod of the uropod has eleven spines but O. S. Tattersall mentions only seven to eight, my specimens have up to twelve in female and thirteen in male. The basal part of the telson is armed with five spines in the female and four in the male, O. S. Tattersall noticed up to six. According to W. M. Tattersall the distal part of the lateral border is armed with eight to nine spines arranged at regular intervals, the gap between the last spine and the outer apical spine being not greater than that between any other two lateral spines. This is not so in my specimens.

W. M. Tattersall mentioned four carpopropodal segments in the thoracic endopods and O. S. Tattersall did not make any mention about this. In my specimens the fourth endopod has four subsegments and the others six subsegments.

The prominent sexual dimorphism of the pleopods has not been observed before in this species.

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# Records of rare Fishes of the Family Chaetodontidae from Bombay

BY

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(*With five text-figures*)

In his paper ' Further records of lobsters from Bombay ' (Chhapgar & Deshmukh 1964), the senior author had remarked on the presence of some species of fishes at Bombay in 1961-62 which do not normally occur there. In the year 1966 this phenomenon was again repeated, this time with fishes of the subfamily Chaetodontinae. The only fish belonging to this subfamily regularly occurring at Bombay is *Chaetodon* (*Chaetodontops*) *collare* Bloch. However, on 8 March, 1966, along with other marine fishes collected on the foreshore at Cuffe Parade (southern Bombay) and brought alive for display at the Taraporevala Aquarium, was a juvenile specimen of the butterfly fish, *Chaetodon* (*Chaetodontops*) *lunula* (Lacépède). More specimens of this species were caught within the next three months. Finally, on 26 May, 1966, along with one specimen of this fish, we received one live specimen each of *Anisochaetodon* (*Linophora*) *auriga* (Forskål), *Anisochaetodon* (*Oxychaetodon*) *lineolatus* (Cuvier & Valenciennes), and *Chaetodon* (*Rhabdophorus*) *xanthocephalus* Bennett. All four fishes are new records for Bombay; Munro (1955) has recorded only two of them, viz., *A. auriga* and *C. xanthocephalus* from Ceylon. A key to their identification and brief descriptions are given below.

### Key to the identification of butterfly fishes of Bombay

1. Scales uniform, with regularly rounded posterior border (*Chaetodon*)........2

   Two kinds of ciliated scales ; large rhombic ones, their posterior border with unequal sides forming an obtuse angle, at least on anterior part of trunk, and much smaller, regularly rounded ones elsewhere (*Anisochaetodon*)........4

2. Spinous dorsal fin nearly twice longer than soft dorsal....................
   ............................*Chaetodon* (*Rhabdophorus*) *xanthocephalus*

   Spinous dorsal fin somewhat longer than soft dorsal (*Chaetodontops*)........3

3. Lower border of eye below a horizontal line passing through the beginning of the gape of the mouth ; lateral line arched.................................................................. *Chaetodon* (*Chaetodontops*) *lunula*

   Lower border of eye touching or slightly above a horizontal line passing through the beginning of the gape of the mouth ; lateral line angular.................................................. *Chaetodon* (*Chaetodontops*) *collare*

4. Snout straight, slightly longer than eye.... *Anisochaetodon* (*Linophora*) *auriga*

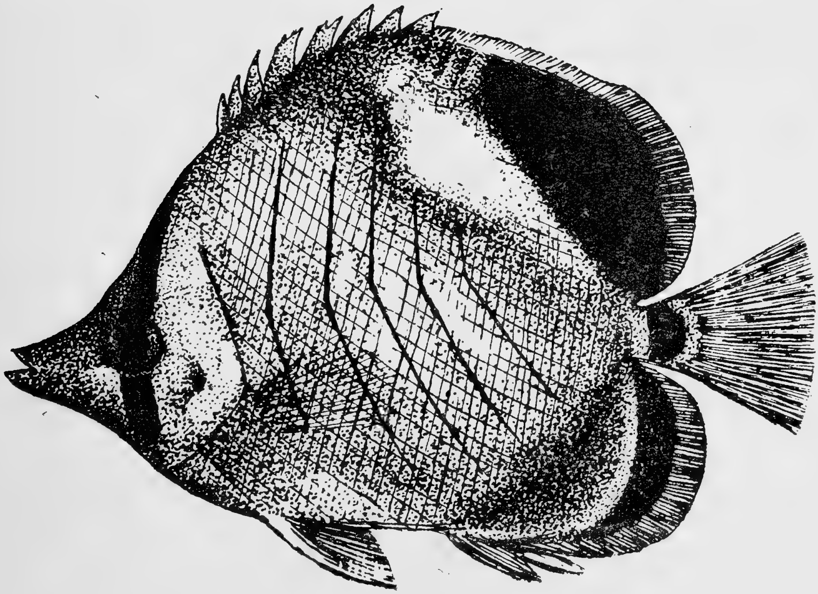
   Snout conical, twice longer than eye.... *Anisochaetodon* (*Oxychaetodon*) *lineolatus*

## **Chaetodon (Rhabdophorus) xanthocephalus** Bennett

*Chaetodon xanthocephalus*, Day, 1887-88, p. 104, 1889, pl. 26; Smith, 1953, p. 239, pl. 32.

*Rhabdocephalus xanthocephalus*, Munro, 1955, p. 174, pl. 34.

The body is silvery-grey. The area covered by a line cutting across from the middle of the dorsal fin to the upper part of the caudal peduncle is jet black. In front of this is a wide oblique white band. The soft portion of the anal fin is smoky grey. The borders of the dorsal and anal fins, as well as the cheeks, and breast are orange. The caudal peduncle is black, but has orange stripes both before and behind it. A black vertical stripe passes through the eye. Five narrow black parallel lines run across the body. In their upper half they are straight and vertical ; in their middle they suddenly turn and run obliquely backward so as to form an obtuse angle. The tail fin is colourless and transparent.

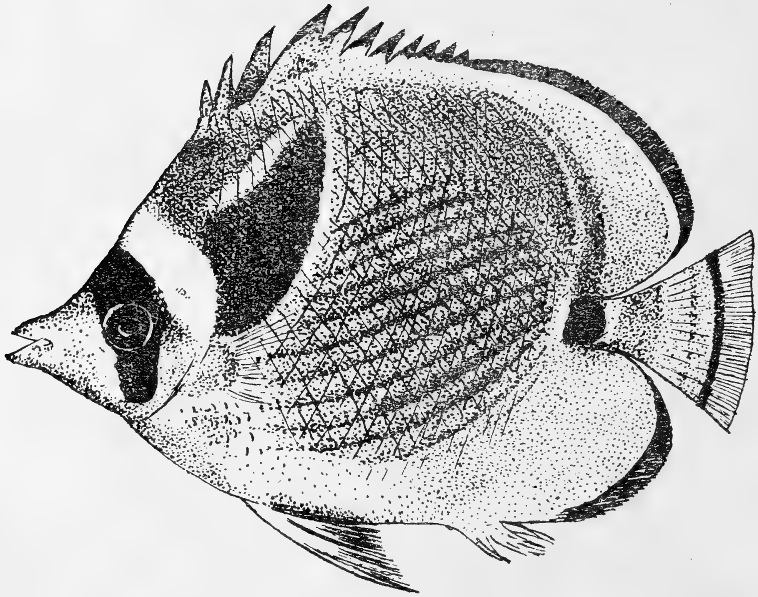


One juvenile specimen, 65 mm. in total length, was caught at Cuffe Parade on 26 May, 1966.

### **Chaetodon (Chaetodontops) lunula** (Lacépède)

*Chaetodon lunula*, Day, 1887-88, p. 108 ; Smith, 1953, p. 238, pl. 31.
*Chaetodon* (*Chaetodontops*) *lunula*, Weber & De Beaufort, 1936, p. 83.

The body is lemon yellow. A black vertical band passes through the eye ; starting above it, on the forehead, and continuing behind it is a backwardly curving white collar. Arising from the middle of the collar and extending backward is a black triangular patch, curving upward but falling far short of the dorsal fin. A dark brown band curves along the top of the body from shoulder to caudal peduncle, widening at both extremities. On the trunk is a series of thin, straight, brown lines running obliquely upward from front to back. The borders of the soft dorsal and anal fins are lined with black, and there is a thin black line separating the yellow caudal peduncle from the transparent, colourless tail fin.



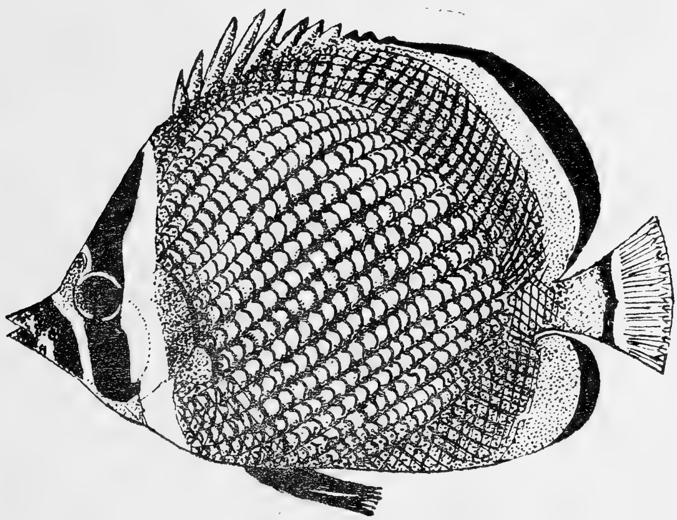
In very young specimens there are two round, white-bordered, black ocelli, the lower one in front of the caudal peduncle and the other being slightly above it. As the fish grows, however, the upper ocellus disappears, while between it and the lower ocellus arises a dark grey, curved line, very thin at the top but widening below. The tips of the spines of the dorsal fin are black.

Five specimens, ranging from 46 to 110 mm. in total length, were caught at Cuffe Parade between 8 March and 26 May, 1966.

### **Chaetodon (Chaetodontops) collare** Bloch

*Chaetodontops collaris*, Munro, 1955, p. 174, pl. 34.
*Chaetodon collaris*, Day, 1887-88, p. 107, 1889, pl. 27.
*Chaetodon* (*Chaetodontops*) *collare*, Weber & De Beaufort, 1936, p. 91.

Body olive brown, tending to red on the dorsal and anal fins. A dark chocolate brown vertical band passes through the eye ; in front of and behind it are vertical white stripes, the latter being broader. The centres of the scales on the body are paler, giving the appearance of parallel stripes on the body obliquely ascending from front to back. The soft dorsal and anal fins are bordered black. The caudal peduncle is carmine red, and is separated from the transparent colourless tail fin by a thin black stripe.



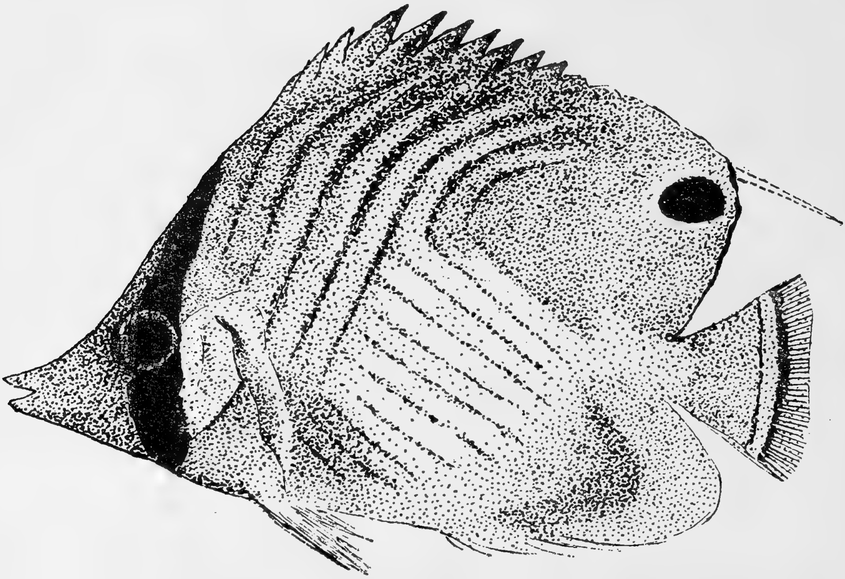
This is the common species of butterfly fish in Bombay, being caught at all sizes from 35 to 120 mm. in total length.

### **Anisochaetodon (Linophora) auriga** (Forskål)

*Chaetodon auriga*, Day, 1887-88, p. 106, 1889, pl. 27 ; Smith, 1953, p. 237, pl. 31.
*Linophora auriga*, Weber & De Beaufort, 1936, p. 103 ; Munro, 1955, p. 175, pl. 34.

The body is white in the middle, but light golden yellow at all edges and especially in the regions of the soft dorsal and anal fins and on the cheeks. The usual black vertical band passing through the eye is present. Across the upper half of the body are five complete and two incomplete dark stripes passing obliquely upward from front to back, while on the lower half of the body are eleven stripes passing obliquely downward

from front to back, and meeting the previously mentioned stripes at right angles. The soft dorsal fin is edged with black. There is an oval black ocellus in the middle of the soft dorsal fin.



One juvenile specimen, 73 mm. in total length, was caught at Cuffe Parade on 26 May, 1966. The setiferous extension of the dorsal fin found in this species is absent in the present specimen.

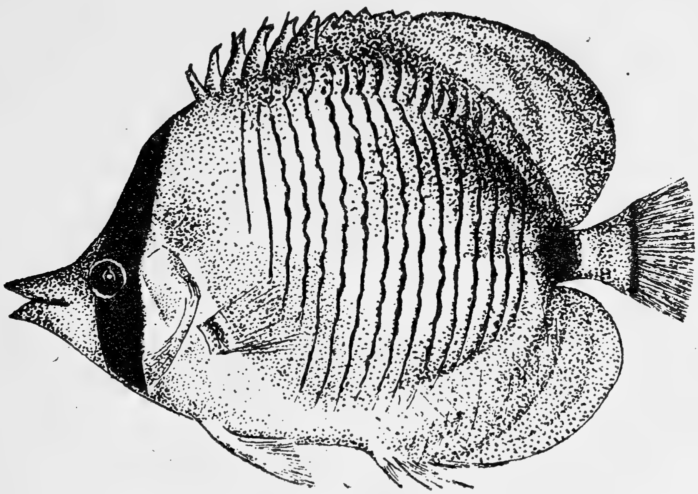
### **Anisochaetodon (Oxychaetodon) lineolatus** (Cuvier & Valenciennes)

*Chaetodon lineolatus*, Smith, 1953, p. 238, fig. 601.

*Anisochaetodon* (*Oxychaetodon*) *lineolatus*, Weber & De Beaufort, 1936, p. 114, fig. 29.

The colour of the body is silvery grey, while the cheeks, the soft dorsal and anal fins (except at the extreme edge) and caudal peduncle are yellow. A black vertical band passes through the eye. A series of 16 wavy black vertical lines cross the body from just behind the pectoral fin up to a dark black patch immediately in front of the caudal peduncle. These lines extend right up to the base of the dorsal fin above, but stop short a little distance above that of the anal fin. The anteriormost three to four wavy bands stop somewhere around the middle of the body. A black crescent-shaped patch runs along the upper posterior border of the body from the commencement of the soft dorsal fin up to and including the caudal peduncle. The caudal peduncle is yellow, with a narrow black posterior edge. Behind this the tail fin is colourless and transparent.

One juvenile specimen, 66 mm. in total length, was caught at Cuffe Parade on 26 May, 1966. This species has been illustrated by Smith



(1953, p. 238) ; however, in his figure the vertical lines are shown straight. Day (1888) records the distribution of this fish as Ceylon and Zanzibar.

## Acknowledgement

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# Preference of Castor varieties for feeding and oviposition by the Leafhopper, *Empoasca flavescens* (F.) (Homoptera, Jassidae) with particular reference to its Honeydew excretion

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(*With two text-figures*)

Seshadri & Seshu (1956) reported differential feeding injury on certain varieties of castor (*Ricinus communis* L.) inflicted by the leafhopper, *Empoasca flavescens* (F.). Further preliminary observations were made by Dorairaj *et al.* (1963) and Jayaraj & Basheer (1964) on castor resistance to this insect. Detailed investigations were made by the author (Jayaraj 1966, 1967a) into the possibility of reducing leafhopper damage through the use of certain specific castor varieties in a study over three seasons (1961-1964) and many sowing periods. In exploring the mechanisms of such resistance and susceptibility in these varieties, the preference-nonpreference component was noted to play an important role. The present observations were, therefore, initiated to study the preference of the leafhopper toward different varieties for feeding and oviposition and toward leaves of different ages in the varieties. The feeding preference was further studied in an indirect way by assessing the rate of honeydew excretion.

## Materials and Methods

The observations were made under insectary conditions with temperature ranging from 21 to 24°C., humidity 80%, and sufficient artificial lighting. Preference for oviposition was studied in respect of four castor varieties, viz., Dominica (susceptible), C3. Pakistan (tolerant), R.C. 1098 Baker (resistant), and R.C. 1096 Coonoor (resistant), in large wire mesh cages. Four plants, one of each variety, were caged together and 50 adult jassids allowed to oviposit in them over a period of 72 hours.

At the end of this period, the adults were killed by ether fumes, and the plants removed and separately caged. The number of nymphs which hatched out in each case was taken as the indication for the number of eggs laid by the leafhoppers. Since the egg stage of the jassid lasts about eight days (Jayaraj & Basheer, 1964), nymphal counts were commenced from the eighth day of the experiment and continued up to the 12th day.

Preference for feeding was studied in a similar manner by introducing fifty freshly hatched nymphs into the cage. The number of nymphs found feeding on the plants was considered as having been attracted by the varieties. The preference of the leafhopper for leaves of different ages was observed under field conditions with respect to the 20 varieties mentioned in Table 2. Weekly counts of leafhopper population, both nymph and adult, were made during the early hours of the morning from 6 a.m. to 8 a.m. with reference to three leaves in each plant selected from the top, middle, and bottom of the main shoot. Thus in all, 27 leaves in nine plants, three in each replication, were examined for each variety at one time. The observations lasted for a total period ranging from 56 weeks in early-maturing varieties to 66 weeks in late types in two seasons, 1962-63 and 1963-64.

*Honeydew experiments:* The preference of the leafhopper for the four varieties was also tested by observing the frequency of honeydew excretion as an indication of the feeding efficiency. A small plastic cage made by placing in juxtaposition two circular, colourless and transparent plastic dishes held in position by means of rubber bands was used for the purpose. One leaf lobe was inserted into the cage at a certain marked position and a single leafhopper introduced at a time and allowed to feed for 24 hours. The position of the leaf lobe inside the cage was shifted once in 6 hours so as to avoid overlapping of the honeydew droplets and to facilitate easy counting. Data were gathered separately for males, females, and first instar nymphs in six replications.

The feeding efficiency of the first instar nymph on the four varieties at different times of the day was studied in another experiment by shifting the leaf lobe position once in two hours, commencing from 6 a.m. When shifting the leaf position in the night, minimum light was used for a short time without disturbing the feeding nymph. This experiment was replicated three times.

In assessing the effect of different colours of light on the jassid feeding, cages made out of red, blue, green, yellow, and colourless plastic dishes were used under fluorescent lighting. The first instar nymph was allowed to feed for six hours and the number of honeydew droplets counted. In this experiment the same four varieties were used in four replications.

## Results

**1. Preference of the jassid for castor varieties for oviposition and feeding**

The number of nymphs hatched out from each plant was considered as an index of the preference for oviposition. The results are given below :

Table 1

Preference of Castor varieties for Oviposition and Feeding

| Variety | No. of nymphs hatched out from each plant (Mean of 8 observations) | No. of nymphs attracted to each plant for feeding (Mean of 10 observations) |
|---|---|---|
| 1. DOMINICA (Susceptible) | 47·5±9·9 | 19·8±0·8 |
| 2. C3. PAKISTAN (Tolerant) | 33·0±3·2 | 15·7±1·3 |
| 3. R.C. 1098 BAKER (Resistant) | 14·1±2·5 | 4·6±0·8 |
| 4. R.C. 1096 COONOOR (Resistant) | 10·4±2·4 | 5·5±0·7 |
| Critical difference (P=0.05) | 16·0 | 3·0 |

The susceptible and tolerant varieties were the most preferred for oviposition and feeding. While these two varieties were preferred alike for oviposition, the susceptible variety attracted significantly more nymphs for feeding.

**2. Preference for leaves of different ages in castor**

The mean population data of the insect on leaves of different maturity of 20 castor varieties observed during 1962-63 and 1963-64 seasons under field conditions are furnished below.

It may be noted from the Table that the jassid population varied significantly in the different varieties as also on the leaves of three ages. The middle leaf harboured the maximum number with a mean of 25·9 followed by the bottom leaf which had a mean population of 20·6. The top leaf had only a mean population of 4·8 jassids. However, when considering individual varieties, the preference of the insect for the varieties varied in respect of the age of the leaves. In both the bottom and middle leaves the varieties differed among themselves very much in the jassid population while most of the varieties behaved alike in the population on the top leaf. The top leaf therefore, cannot serve as a sound

basis for the evaluation of castor varietal resistance. In any case, the analysis of the population data leaves no doubt that the preference of the

TABLE 2

COMPARISON OF JASSID INCIDENCE ON LEAVES OF THREE AGES IN CASTOR VARIETIES

| Variety | | Jassid population | | | Mean |
|---|---|---|---|---|---|
| | | Bottom leaf | Middle leaf | Top leaf | |
| *Resistant* | | | | | |
| 1. R.C. 1098 Baker | .. | 3·3 | 4·5 | 1·6 | 3·1 |
| 2. R.C. 1094 Cimmerron | .. | 7·6 | 10·1 | 3·0 | 6·9 |
| 3. R.C. 1096 Coonoor | .. | 8·8 | 11·3 | 2·6 | 7·5 |
| *Intermediate (Tolerant)* | | | | | |
| Group I | | | | | |
| 4. R.C. 1077 South Africa | .. | 12·6 | 19·9 | 5·0 | 12·5 |
| 5. Mauthner's Dwarf | .. | 11·0 | 21·1 | 8·3 | 13·5 |
| 6. R.C. 1095 U.S. 74 | .. | 16·7 | 20·0 | 3·7 | 13·5 |
| 7. R.C. 552/1 Nagpur | .. | 13·5 | 20·4 | 4·8 | 12·9 |
| Group II | | | | | |
| 8. R.C. 817 Koilpatti | .. | 18·7 | 18·2 | 3·1 | 13·3 |
| 9. R.C. 826 Russia | .. | 22·2 | 18·2 | 2·6 | 14·3 |
| 10. E.B. 26/1 M.P. | .. | 23·3 | 18·3 | 2·5 | 14·7 |
| 11. T.M.V. 1 | .. | 17·2 | 29·4 | 6·0 | 17·5 |
| Group III | | | | | |
| 12. C3. Pakistan | .. | 28·6 | 28·2 | 3·8 | 20·2 |
| 13. R.C. 488 Egypt | .. | 27·6 | 29·3 | 4·7 | 20·5 |
| 14. R.C. 842 Cuddapah | .. | 25·6 | 26·7 | 4·4 | 18·9 |
| 15. T.M.V. 3 | .. | 42·3 | 44·7 | 5·6 | 30·9 |
| 16. Co. 1 | .. | 31·6 | 33·6 | 4·7 | 23·3 |
| 17. T.M.V. 2 | .. | 44·3 | 64·0 | 6·7 | 38·3 |
| *Susceptible* | | | | | |
| 18. R.C. 1092 Italy | .. | 14·5 | 20·8 | 6·8 | 14·0 |
| 19. Israel M.E. | .. | 17·7 | 33·5 | 6·6 | 19·3 |
| *Highly Susceptible* | | | | | |
| 20. Dominica | .. | 25·0 | 44·9 | 10·2 | 26·7 |
| Mean | .. | 20·6 | 25·9 | 4·8 | |

Difference between varieties significant at the 1% probability level. C.D. (P=0·05) 2·8.
Difference between leaves significant at the 1% probability level. C.D. (P=0·05) 1·1.
Interaction between varieties and leaves significant at the 1% level. C.D. (P=0·05) 5·0.

jassid is for the susceptible and tolerant varieties. The susceptible variety, Dominica, and tolerant varieties like T.M.V. 2 and T.M.V. 3 were preferred to resistant varieties like Baker and Cimmerron.

### 3. Honeydew excretion as an index of feeding preference

*(i) Excretion of jassid nymph and male and female adults fed on four varieties*

The excretion of the leafhopper, in general, is directly related to the intake of plant sap. Therefore, the number of honeydew droplets excreted by the insect in unit time when fed on different castor varieties is considered as an index for its feeding preference. This assumption is further based on the earlier findings of Maxwell & Painter (1959) who reported the possibility of using the rate of honeydew deposition to measure the degree of resistance of host plants, the rate of ingestion of plant material, and to serve as a crude measure of the metabolic activity of the insect. The honeydew excretion of the nymph and male and female adults was compared and the data illustrated in Fig. 1.

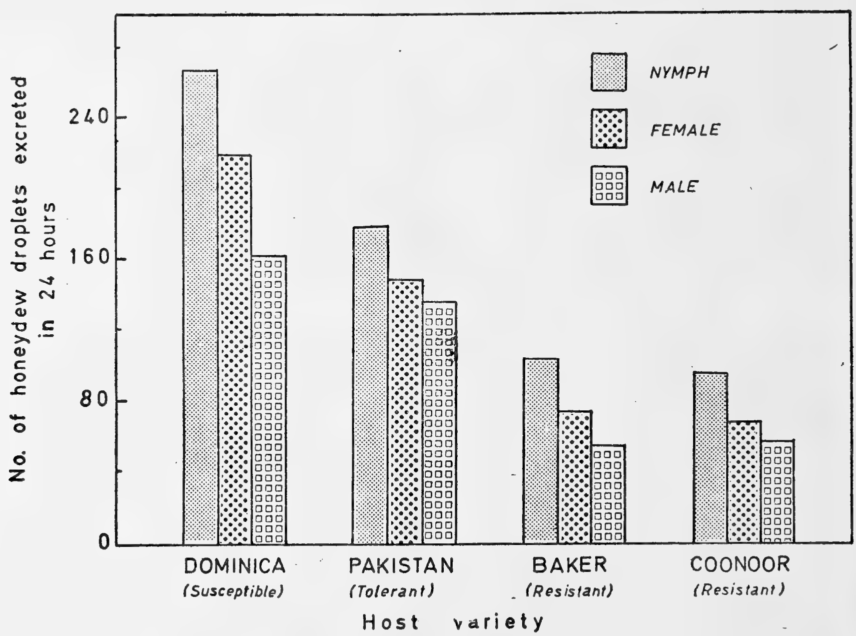


Fig. 1. Honeydew excretion of jassid nymph, male and female adults fed on four castor varieties.

The results show the markedly higher level of excretion of the leafhopper when fed on the susceptible and tolerant varieties than when fed on the resistant ones. Irrespective of the stage or sex of the insect, the jassid excreted on an average 217·8 droplets in a day when fed on Dominica variety and 155·3 on Pakistan variety as against only 75·9 and 69·6 on the resistant Baker and Coonoor varieties respectively. Nymphs caused maximum damage excreting 161·8 honeydew droplets

followed by female (126·9) and male (100·3) adults. The feeding and excretory activity of both the sexes were statistically alike when fed on the tolerant and resistant varieties, while the female excreted significantly more than the male when fed on the susceptible variety.

### (ii) *Influence of colour on excretion*

Colour affected the honeydew excretion of this leafhopper. Jassids confined in transparent plastic cages of different colours reacted differently in respect of feeding and honeydew excretion. The data of honeydew drops excreted by first instar nymphs are presented in Table 3

TABLE 3

EFFECT OF DIFFERENT COLOURS ON THE RATE OF HONEYDEW EXCRETION LEAFHOPPER NYMPHS FED ON FOUR CASTOR VARIETIES

| Variety | No. of honeydew droplets excreted by a first instar nymph in six hours (Mean of four observations) | | | | | |
|---|---|---|---|---|---|---|
| | White | Red | Blue | Green | Yellow | Mean |
| 1. **Dominica** (Susceptible) .. | 72·3 | 10·3 | 48·0 | 67·8 | 18·3 | 43·3 |
| 2. **C3. Pakistan** (Tolerant) .. | 60·5 | 10·8 | 47·8 | 64·5 | 21·5 | 41·0 |
| 3. **R.C. 1098 Baker** (Resistant) .. | 34·0 | 9·0 | 29·0 | 29·0 | 13·5 | 22·9 |
| 4. **R.C. 1096 Coonoor** (Resistant) .. | 24·0 | 8·5 | 35·0 | 35·0 | 13·8 | 23·3 |
| Mean .. | 47·7 | 9·6 | 39·9 | 49·1 | 16·8 | |

Difference between varieties significant at the 1% probability level. C.D. (P=0·05) 6·5.

Difference between colours significant at the 1% probability level. C.D. (P=0·05) 22·9.

Interaction between varieties and colours significant at the 1% probability level. C.D. (P=0·05) 14·5.

Normal feeding activity and excretion were observed on exposure to green, white, and blue lights. Marked differences in the number of honeydew drops excreted by the leafhopper fed on the susceptible and tolerant varieties on the one hand and on the resistant varieties on the other were noticeable only under these colours. Very low honeydew deposition was noted in yellow and red lights and all the varieties gave

like results. Thus, besides indicating the effect of colour on the jassid excretion, this experiment also confirmed the preference of the insect for the susceptible and tolerant varieties in preference to the resistant varieties.

### (iii) *Honeydew excretion at different times of the day*

The feeding activity of the leafhopper fluctuated at different times of the day. To estimate this, honeydew deposition by first instar nymphs fed on four castor varieties was observed at intervals of two hours. The results are illustrated in Figure 2.

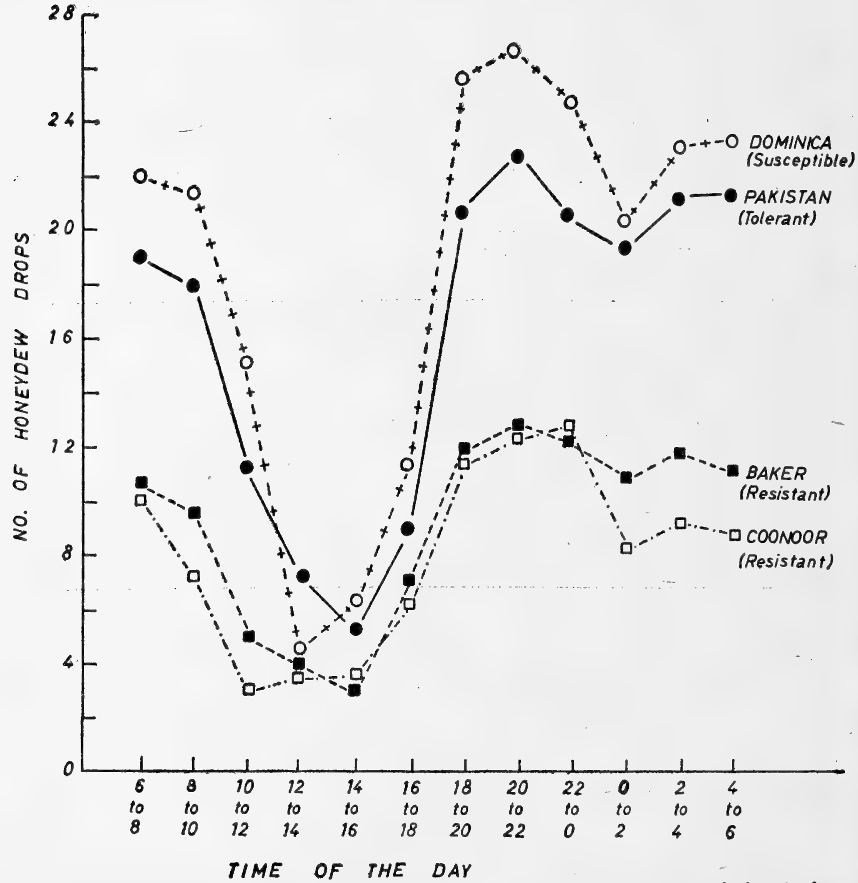


Fig. 2. Honeydew excretion of jassid nymphs fed on tour castor varieties during different times of the day.

As in the previous experiments the number of honeydew droplets excreted by the leafhopper was significantly higher when fed on the susceptible and tolerant varieties than when fed on the resistant varieties.

Excretion was markedly more during the night than during the day—100·2 droplets were excreted by a jassid nymph in the night hours from 6 p.m. to 6 a.m. as against only 55·8 from 6 a.m. to 6 p.m., taking all the varieties together. The feeding activity and consequently the excretion were least during the hotter hours from 12 noon to 4 p.m. and maximum between 8 p.m. and 10 p.m. (Fig. 2). However, the differences between varieties in this regard were still maintained. The interaction between varieties and periods within day and night was not significant.

In all the above honeydew experiments it was observed that the honeydew droplets excreted by the leafhoppers that fed on susceptible and tolerant varieties were comparatively big, dark green, and opaque, while those on resistant varieties were much smaller, pale green to colourless, and translucent to transparent.

## Discussion

It is interesting to note that under field as well as under insectary conditions, the jassid prefers the susceptible and tolerant varieties for feeding and oviposition (Tables 1 and 2). The efficiency with which the preferred host-varieties are discovered by the leafhoppers arouses interest and curiosity. The plausible explanation for their preference lies among other factors in the nutritional superiority of the susceptible and tolerant varieties over the resistant ones as surmised by Lipke & Fraenkel (1956) for phytophagous insects in general. In other words, the nutritional requirements of the jassid may have a direct bearing on host selection. In fact Painter (1958) has pointed out that not much emphasis has been placed on the use of resistant varieties, particularly resistant and susceptible isogenic pairs, as tools in the study of insect nutrition. The role played by the chemical senses of the insect in the matter of host selection may also be of much significance in this connection (Dethier 1953, 1954).

The susceptible variety Dominica and the tolerant variety C3. Pakistan contain higher quantities of total nitrogen, free amino acids, and peptides than the resistant R.C. 1098 Baker variety (Jayaraj 1967b). The resistant varieties were not preferred by the insect owing to their nutritional inferiority. These varieties had higher concentrations of total carbohydrates, sucrose and glucose than the susceptible and tolerant varieties, and in addition had fructose (Jayaraj 1967b). As the leafhoppers have been observed to avoid higher concentrations of sugars, particularly sucrose (Nuorteva 1952), the increased quantity of sugars present in resistant varieties may be supposed to repel the jassids.

As reported by Kennedy (1953) in the case of *Aphis fabae* Scop., the leafhopper *Empoasca flavescens* also seems to be capable of discriminating between different castor varieties and the leaves of different ages within the variety. The jassids are undoubtedly better adapted and in a better

position to do so than the aphids because of their more active habits. The middle and bottom leaves are generally preferred to the top leaves. Aphids, however, prefer tender leaves (Kessler *et al.* 1958 ; Kennedy 1958).

Maxwell & Painter (1959) reported the possibility of using the rate of honeydew deposition to measure the degree of resistance of host plants, the rate of ingestion of plant material, and to serve as a crude measure of the metabolic activity of the insect. The frequency of honeydew excretion was significantly higher in *E. flavescens* fed on the preferred hosts than when fed on nonpreferred resistant varieties (Fig. 1). Auclair (1958, 1959) observed that the honeydew droplet volume, the frequency, and rate of excretion in *Acyrthosiphon pisum* (Harr.) were generally proportional to the susceptibility of the pea variety. Maxwell & Painter (1959) also found increased frequency of honeydew excretion in *Toxoptera graminum* (Rond.) and *Therioaphis maculata* (Buck) fed on various alfalfa clones, and wheat and barley varieties varying in susceptibility to aphid attack.

The nymphs of *E. flavescens* excreted more honeydew than adults, and generally the female caused more damage than the male (Fig. 1). It has also been found that when the nymph/adult ratio is high, percentage hopperburn is high (Jayaraj 1967c), a phenomenon, in part, due to the voracious nature of the nymphs and their ability to drain more plant sap. The frequency of excretion by the adults of the aphid *Tuberolachnus salignus* (Gmelin) was much less than that of the nymphs (Mittler 1958) whereas in the aphid *Acyrthosiphon pisum* (Harr.) it was higher in the adults (Auclair 1958).

The higher deposition of honeydew in the night time recorded in the present studies (Fig. 2) may be because of the increased feeding activity of the leafhopper which prefers lower temperatures (Jayaraj 1964). The fact that red light retards the feeding and excretory activities of the leafhopper (Table 3) suggests an explanation for the less preference of the red-leaved variety R.C. 1092 Italy which is, however, a nontolerant variety classified under the susceptible category (Jayaraj 1967a).

## Summary

In the mechanisms of resistance in castor (*Ricinus communis* L.) to the leafhopper, *Empoasca flavescens* (F.), the nonpreference component was found to play an important role. Evidence has been presented to show that for feeding and oviposition the insect preferred Dominica (susceptible) and C3. Pakistan (tolerant) varieties to the resistant R.C. 1098 Baker and R.C. 1096 Coonoor varieties. The preference among the 20 varieties was for the susceptible and tolerant types and for the middle and bottom leaves rather than the top leaves within the plant.

The nymphs and adults fed on susceptible and tolerant hosts excreted more honeydew than those fed on resistant plants. The excretion of honeydew was found to be more frequent in the case of nymphs as compared with adults. Normal feeding activity and excretion were observed on exposure to green, blue, and white lights, while yellow and red reduced the excretion. Excretion was significantly more during night than in the day, and was much retarded during the hotter hours on all the varieties.

The plausible mechanism of the preference or nonpreference is explained from the nutritional point of view.

## Acknowledgements

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# Observations on Age and Growth of *Tachysurus sona* (Ham.)[1]

BY

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(*With eight text-figures*)

## INTRODUCTION

The sub-order Siluroidea is represented mainly by the family Tachysuridae (Ariidae) along the Bombay coast, where it is of considerable economic importance. Its fishery along the coast has improved considerably with the recent introduction of mechanised fishing boats and motor trawlers which have more or less replaced the use of hook and line (restricted to the monsoon season only) as the principal mode of capture of catfishes. Catfishes ranked second in the total marine fish catches of Maharashtra for the years 1962-63 and 1963-64 (Annual Report 1963-64, Department of Fisheries, Maharashtra). Of the six species of commercial importance along the Bombay coast, the husky catfish, *Tachysurus sona* locally known as 'Shigala' ranks first, constituting about 60% of the catfish catches. Practically no information is available on the biology of this fish. The present study, however, deals only with the age and growth of the fish.

Growth studies of fishes have become an important aspect of fishery biology investigations in view of their use in population models for estimating the yield of a fishery. The yield estimate from population models such as those given by Beverton & Holt (1957) is obtained in terms of weight of the fish caught, for which a correct knowledge of growth parameters and length-weight relationship are necessary besides other vital statistics like catch and effort. The growth parameters obtained in the present study are based on vertebral reading supplemented by the evidence obtained from the length-frequency polygons.

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## Material and Methods

The material which formed the basis of the present study was collected from the catches of bag-nets (*Dol jal*), long-lines and trawls at Sassoon Dock. Some samples were also collected from different landing places in Bombay such as Chaupatty and Versova, during the monsoon months. Samples were collected at fortnightly intervals and care was taken to collect an unbiased sample of the catch.

Total length of each fish was measured to the nearest millimetre from the tip of the snout to the tip of the upper lobe of the caudal fin. Weight of the fish was taken to the nearest gramme by using a Salter pan balance for smaller fishes but for bigger fishes, weighing one kilogram or more, a spring balance was used.

For age reading, fifth vertebra which lies behind the 'complex vertebra' described by Karandikar & Masurekar (1954) was selected as it is flat and easy to separate. The use of vertebrae was necessitated by the absence of scales in *T. sona.* Pantulu (1961, 1962 & 1963) developed the use of pectoral spines in medium sized catfishes, while Saigal (1963) pointed out that vertebrae can also be used in determining the age of the freshwater catfish, *Mystus aor* (Ham.). Since *T. sona* grows to a large size, the use of pectoral spine could not be made for age reading because of difficulties in obtaining suitable sections. Many earlier workers have made use of vertebrae for the study of age and growth of fishes, (Heincke 1908, Appleget & Smith 1951, Partlo 1955, Mather & Schuck 1960).

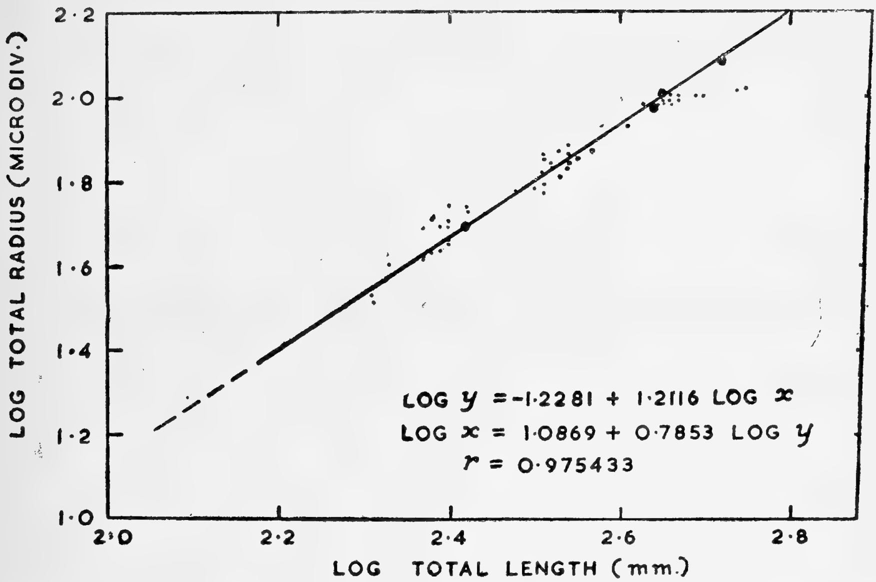
For obtaining the fifth vertebra a portion of the body containing the first few vertebrae was cut off and boiled in water for about five minutes so as to remove the adhering tissue. Then the fifth vertebra was separated from the rest with the help of a scalpel. While separating the vertebra, all possible care was taken not to damage the margin of the vertebra. In some cases where the margins were found damaged, the specimens were discarded. The vertebrae were cleaned in ether so as to remove adhering fat and then kept in glycerine for about a week until the growth rings became clearly visible. To discriminate the true and false rings, a few vertebrae with very clear rings were stained by Galtsoff's (1952) method and kept as model specimens for comparison.

The vertebrae showed alternating narrow (dark) and wide (opaque) concentric zones, around a centre. True and false rings could be easily distinguished by their circular continuity or discontinuity respectively.

The distance of each ring was measured from the centre along a radial plane to the longest axis of the vertebra. Measurement of each zone was done by a micrometer eye piece. In all fifty-one vertebrae were examined and growth checks from each were measured.

## AGE AND GROWTH

The length of *T. sona* at the time of formation of successive annuli was back calculated for each fish by making use of the relationship between the radius of the vertebrae and the length of the fish.




Text-Fig. 1. Relation between vertebral radius and total length of the fish. Points denote observed values.

This relationship is shown in Figure 1 and was found to be linear in the logarithmic form which can be expressed as

$$\log y = a + b \log X$$

where y=radius of the vertebrae and X=length of the fish and 'a' and 'b' are the two constants. The straight line relationship between the vertebral radius and length of *T. sona* is found to be

$$\log y = -1{\cdot}2281 + 1{\cdot}2116 \log X \quad \ldots\ldots (1)$$

which can be conversely expressed as

$$\log X = 1{\cdot}0869 + 0{\cdot}7853 \log y \quad \ldots\ldots (2)$$

The correlation coefficient 'r' of the two variables is found to be 0·975433, which is highly significant.

In deriving a formula for back-calculation it was considered more appropriate to take into consideration the regression of the total length on radius of the vertebrae (2), (Smith 1955, Pantulu & Singh 1962, and Pantulu op. cit.). Based on this relationship the following formula for

back-calculating lengths, at the time of formation of different annuli, was used.

$$\log l_n = \log L_t + b\ (\log r_n - \log R_t).$$

Where ln=length at age n ; Lt=length at the time of capture ; $r_n$=radius of the vertebra at age n ; $R_t$=the total radius of the vertebra at the time of capture ; and b=slope of the regression line. The advantage in using this formula is that the estimates are based on a calculated slope which eliminates any errors arising when a direct relationship is assumed. The mean values of the back-calculated lengths are presented in Table 1.

TABLE 1

MEAN BACK CALCULATED LENGTHS (MM.) AT THE END OF EACH YEAR OF LIFE OF ALL AGE GROUPS OF *T. sona*

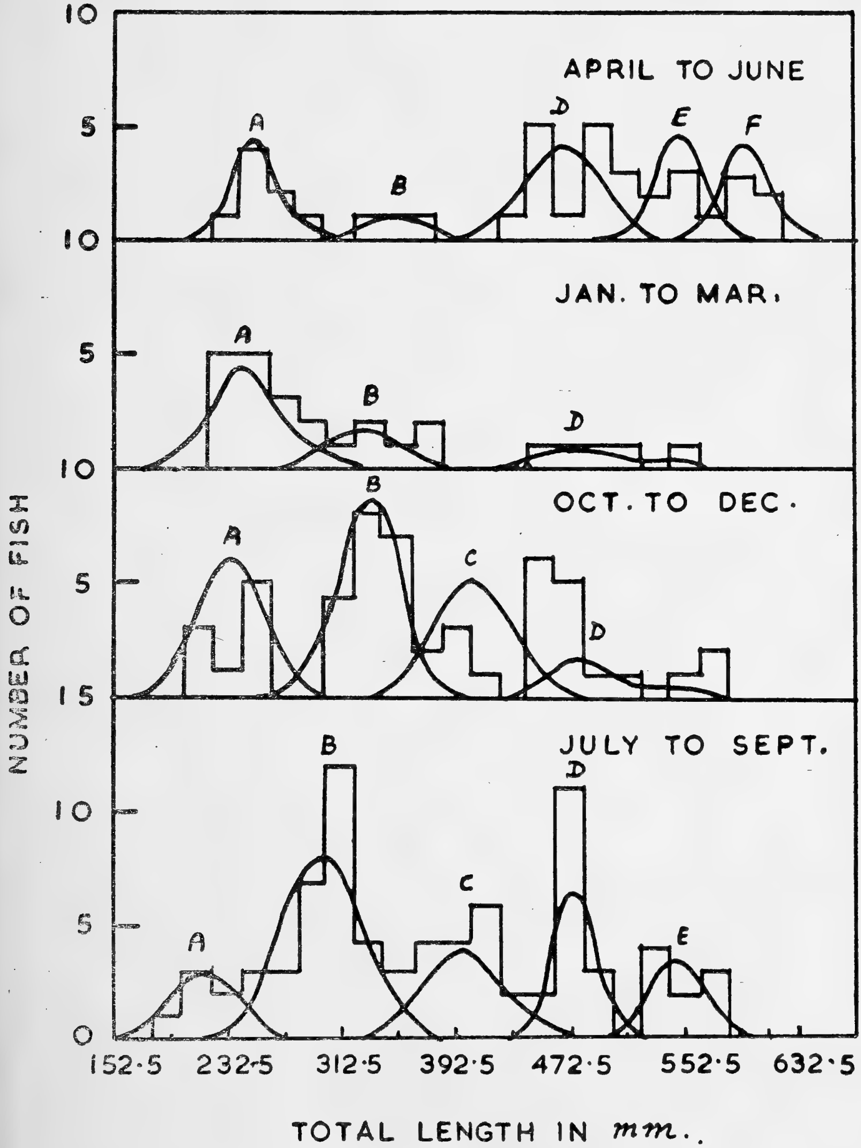
| Length at capture | Number of Specimens | Age in years | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 205 | 2 | 183·2 | — | — | — | — |
| 265 | 3 | 192·9 | 298·3 | 369·2 | — | — |
| 325 | 4 | 228·9 | 292·7 | 398·7 | — | — |
| 345 | 4 | 229·6 | 284·4 | 299·7 | 323·2 | — |
| 352 | 6 | 212·9 | 287·1 | 307·0 | 390·9 | — |
| 393 | 4 | 270·9 | 306·8 | 356·0 | 393·2 | — |
| 405 | 2 | 261·0 | 310·7 | 373·5 | 395·6 | 400·7 |
| 413 | 1 | 265·5 | 326·6 | 372·2 | 395·0 | — |
| 435 | 3 | 271·9 | 337·0 | 386·3 | 408·6 | 428·0 |
| 445 | 3 | — | 345·7 | 380·2 | 410·4 | 431·4 |
| 450 | 2 | 284·4 | 351·4 | 393·4 | 422·6 | 437·5 |
| 460 | 4 | 223·6 | 339·5 | 395·5 | 416·2 | 434·9 |
| 465 | 1 | 202·1 | 354·8 | 400·7 | 429·0 | 454·0 |
| 470 | 2 | 212·7 | 342·9 | 407·4 | 431·3 | 465·1 |
| 500 | 4 | 205·6 | — | 398·9 | 433·2 | — |
| 510 | 1 | — | 361·3 | 415·9 | 450·4 | 475·8 |
| 550 | 3 | 242·5 | 379·5 | 405·0 | 466·5 | 505·4 |
| 570 | 2 | — | 318·4 | 403·9 | 472·0 | 534·4 |
| Total | 51<br>Mean | 229·9 | 315·6 | 384·4 | 417·0 | 454·0 |

The length frequency polygons as have been used by many workers for determining the age of fishes was found to be very useful in the case of *T. sona* which has a restricted spawning season (Singh 1965).

Cassie (1954) made use of the arithmetic probability paper to dissect out different length groups and determine graphically the mean and the standard deviation of each group. The method suggested by Cassie (op. cit.) has been followed in the present study. After estimating the mean and the standard deviation, the frequency distribution was

calculated by using the value of $\frac{x-\bar{x}}{\delta}$ as argument to enter the probability table where $(x-\bar{x})$ is the difference between the mean length and a given value.

The modal values of the length frequency distribution in the first quarter given in Table 2 and plotted in figure 2, were 212·5, 296·5,




Text-Fig. 2. Size frequency distribution of *T. sona* for the year 1963-64 represented quarterly. The year classes have been separated by probability plot.

396·5, 472·5, and 544·5 which were designated as 'A', 'B', 'C', 'D', and 'E' respectively for convenience of following their subsequent progression. The mode 'A' showed a progression of 20 mm. by the time it reached the second quarter that is from October to December, in the third and fourth quarters that is from January to March and from April to June an increase of 12 mm. and 8 mm. respectively was observed.

TABLE 2

MEAN VALUES OF LENGTH OF DIFFERENT SIZE GROUPS SEPARATED BY PROBABILITY PLOT AND MODES CORRESPONDING TO VARIOUS CLASSES GROUP ASSIGNED

| Expected age group | Year 1963-64 | | | |
|---|---|---|---|---|
| | July to September | October to December | January to March | April to June |
| 1 (A) | 212·5 (24·0) | 232·5 (20·0) | 244·5 | 252·5 (15·0) |
| 2 (B) | 296·5 (26·0) | 327·5 (19·0) | 330·5 (29·0) | 344·5 (26·0) |
| 3 (C) | 396·5 (36·0) | 404·5 (12·0) | — | — |
| 4 (D) | 472·5 (15·0) | 482·5 (40·0) | 492·5 (36·0) | 500·5 (30·0) |
| 5 (E) | 544·5 (29·0) | — | — | 552·5 (5·0) |
| 6 (F) | — | — | — | 587·5 (15·0) |

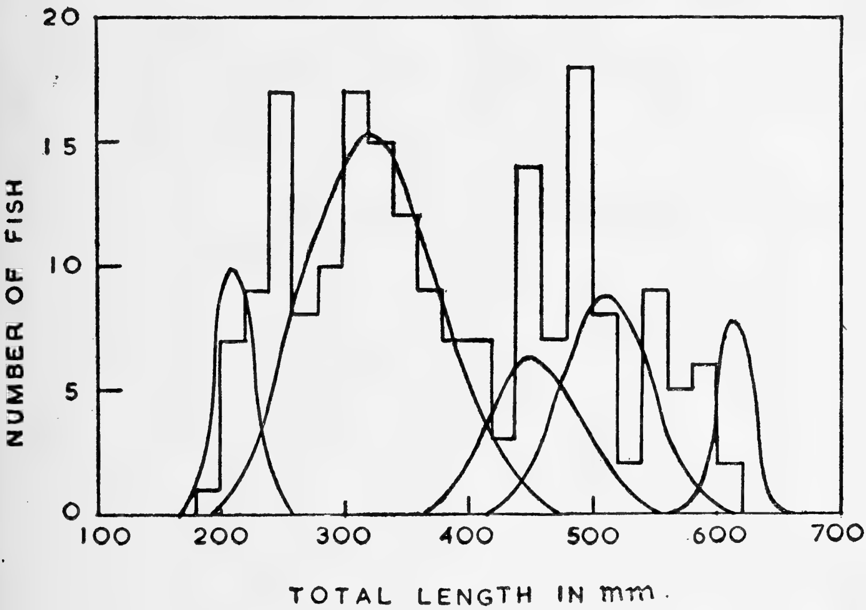
Note: The standard deviation is given in parentheses, A. B. C. D. E. F, indicate modes in Fig. 2.

The progression of the mode marked as 'B' from the first quarter to the second quarter was found to be 35 mm. showing no substantial progression in subsequent quarters. The mode 'C' showed a moderate increase from the first quarter to the second quarter, being completely absent in the samples examined during the remaining period. The mode 'D' remained at the same value throughout the year whereas 'E' appeared in the first quarter and again in the last quarter and 'F' only in the last quarter.

The above account does not give any reliable index of the increase in length from one quarter to the next of each year class probably because the samples were not large enough to account for shifting of the modes from one year class to the next. However, it did give a rough estimate of different year classes in different quarters of the year.

It may be seen that the younger age-groups below five years were present only in the samples obtained during October-March, while in the next half year (April-September) the samples were fairly well represented by older fish.

When the length frequency distribution of all the samples, obtained during the period June 1963 to June 1964, were plotted as histograms (Fig. 3) and the normal curves were fitted to the data, by following the




Text-Fig. 3. Size frequency distribution of *T. sona* for 1963-64, showing the various year classes separated by the probability method.

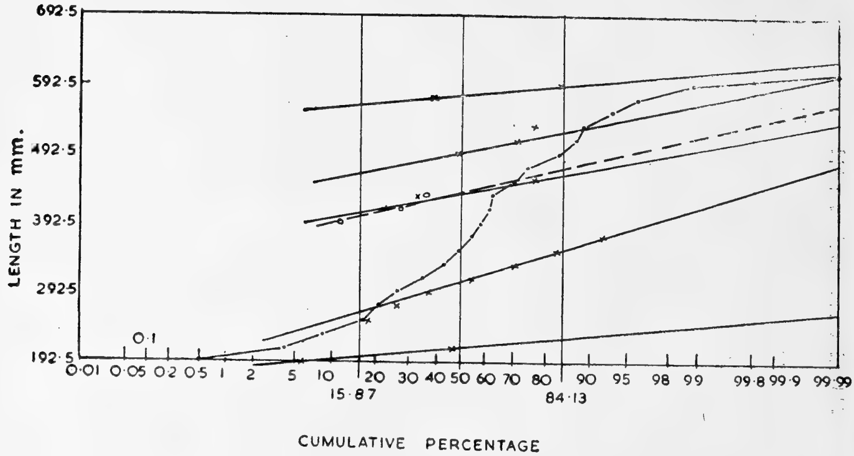
TABLE 3

MEAN VALUES AND STANDARD DEVIATIONS OF DIFFERENT SIZE GROUPS IN THE POOLED SIZE FREQUENCY DISTRIBUTION

| Year Class | m | s | Percentage of total | n |
|---|---|---|---|---|
| 1 | 212·5 | 12 | 8·8 | 17 |
| 2 | 307·5 | 49 | 49·3 | 95 |
| 3 | — | — | — | — |
| 4 | 432·5 | 40 | 16·1 | 31 |
| 5 | 492·5 | 33 | 19·1 | 37 |
| 6 | 572·5 | 17 | 6·7 | 13 |
| | | | 100·0 | 193 |

m=mean.
s=standard deviation.
n=number.

method described above, the mean values obtained by the probability plot were 210, 325, 450, 510 and 610 (Fig. 4). These are given in Table 3 along with their standard deviations. The modal values thus obtained agreed very closely with the back calculated lengths of different year-classes (Table 4), determined from the zones on the vertebrae. However, in the third year the modal length 384·4 mm. did not agree well. This may be probably due to the absence of this year-class in the length frequency histograms.




Text-Fig. 4. Probability plot of the length frequency distribution of *T. sona* showing the method of separating the theoretical curve components.

TABLE 4

COMPARISON OF MEAN LENGTH CALCULATED BY BACK CALCULATION AND LENGTH FREQUENCY DISTRIBUTION

| Age in years | Vertebral studies | Modes of length frequency |
|---|---|---|
| 1 | 229·9 | 210 |
| 2 | 315·6 | 325 |
| 3 | 384·4 | — |
| 4 | 417·0 | 450 |
| 5 | 454·0 | 510 |
| 6 | — | 610 |

The close correspondence between the back calculated average lengths and the observed modal lengths substantiates the validity of growth checks on the vertebrae as annular and justifies their use for age determination. In the case of *T. sona*, the formation of the clear cut growth rings on the vertebrae may probably be attributed to the stress of spawning, which is annual and restricted to a short period. In addition to

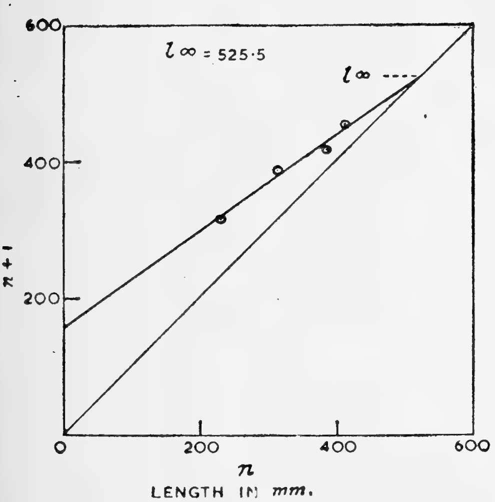
that, the habit of buccal incubation of eggs in this fish, leads to a suspension of feeding which probably acts as a growth retarding factor (Singh op. cit.).

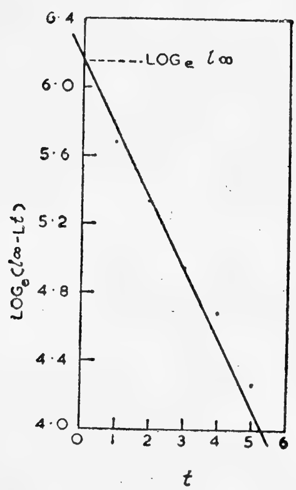
*Empirical Growth*

The von Bertalanffy (1938, 1957) growth equation,

$$l_t = l\infty\,(1 - e^{-k\,(t - t_o)})$$

where $l_t$=length at age t ; $l\infty$=maximum length to which the fish can grow ; K=catabolic coefficient ; t=age of fish ; $t_o$=theoretical value of age when length is zero, is used for fitting the growth curve of *T. sona* ; the value of $l\infty$ was determined by using the graphical method of Walford (1946), (Fig. 5). The value of $t_o$ is calculated graphically according to the method given by Ricker (1958) and is shown in Fig. 6.




Text-Fig. 5. The length and age data plotted at age t against length at age t+1. The intersection of the bisector gives an estimate of L∞

Text-Fig. 6. Log (L∞−1t) plotted against age ' t ' for estimating $t_o$.

The estimated values of $l\infty$ ; k and $t_0$ describing the growth of *T. sona* are as follows :

$$l\infty = 525{\cdot}5,\ k = 0{\cdot}3507,\ t_0 = -0{\cdot}69.$$

The von Bertalanffy growth equation of *T. sona* may be written as,

$$l_t = 525.5\ (1 - e^{-0.3507\ (t-(-0.69))})$$

From the above growth equation the length of a fish at various year-classes can be calculated. The calculated values of lengths at different ages are given in Table 5. These were found to agree closely with the observed lengths at different ages.

*Length-weigth Relationship.*

The weight of the ungutted fish was taken to the nearest gramme and the average weight when plotted against 10 mm. size interval

TABLE 5

AVERAGE LENGTHS OF *T. sona* ESTIMATED BY VARIOUS METHODS CORRESPONDING TO YEAR-CLASSES

| Age in years | Vertebra studies | Theoretical growth equation | Modes of length frequency distribution |
|---|---|---|---|
| 1 | 229 | 234 | 210 |
| 2 | 315 | 320 | 325 |
| 3 | 384 | 380 | — |
| 4 | 417 | 423 | — |
| 5 | 454 | 453 | 450 |
| 6 | | 474 | — |
| 7 | | 489 | — |
| 8 | | 499 | — |
| 9 | | 506 | — |
| 10 | | 512 | 510 |

(Fig. 7), gave the relationship of the curvilinear type. This can be described by the equation :

$$W = aL^{b}$$

The equation can also be written as,

$$\log W = \log. a + b \log L.$$

Accordingly, the length-weight relationship of *T. sona* was found to be as

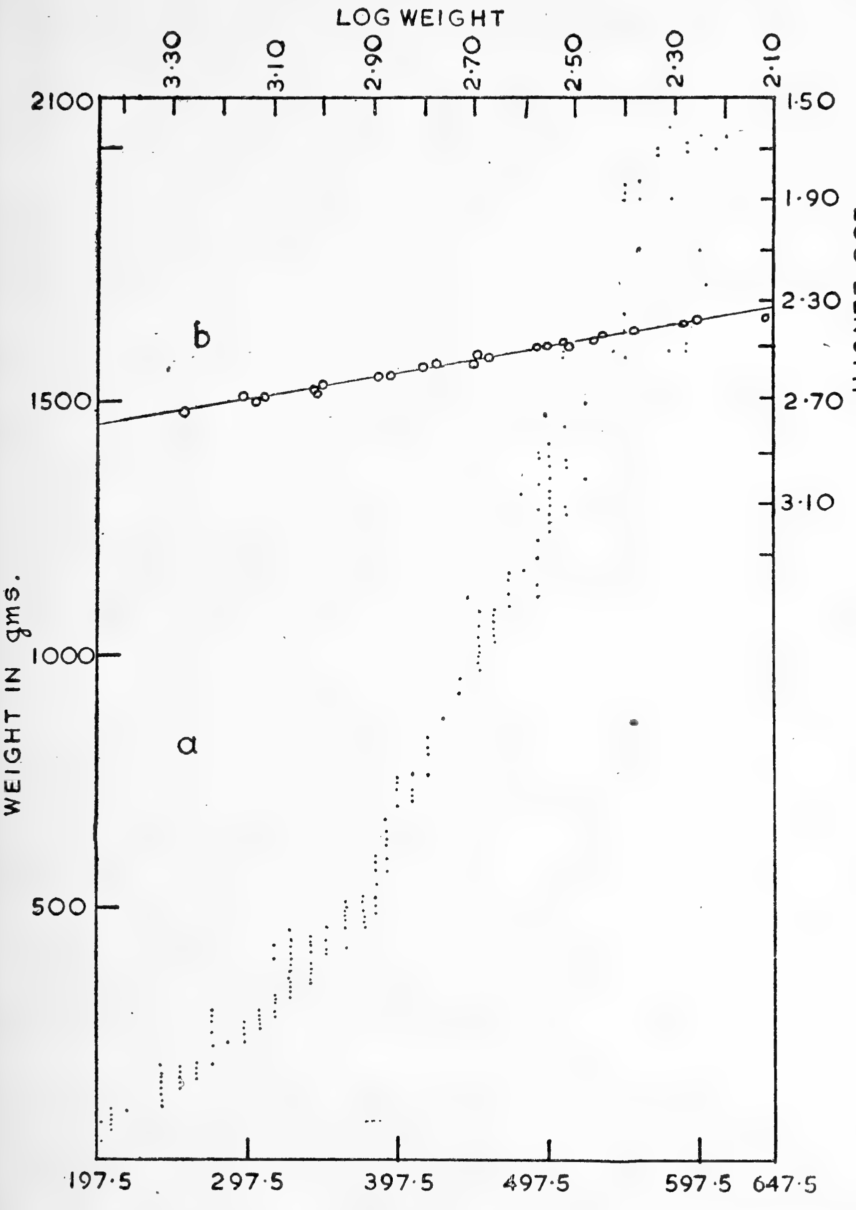
$$\log W = -4{\cdot}794868 + 2{\cdot}932107 \log L.$$

The coefficient of correlation 'r' $= 0{\cdot}9848$ is highly significant and shows that the relationship follows strictly the cube law, which is not always true in catfishes. Appleget & Smith (1951) gave the value of 'b' as 3·66, in channel catfish which shows that weight increases at a power much greater than the cube of the length, indicating that the relationship between length and weight deviates from the cube law.

*Relative condition*

The changes in the condition of the fish or the 'k' value largely depend on the **state** of the fish and therefore it gives a good indication of the spawning period. Le Cren (1951), reviewed the limitations of using the formula $K = \frac{W}{l_3} \times 100$ in the case of those fish which do not obey the cube law and suggested a modification to account for the deviation in the length-weight relationship. The modified formula is $K_n = \frac{W}{\hat{W}}$ where 'W' is the observed weight and $\hat{W}$ is the calculated weight

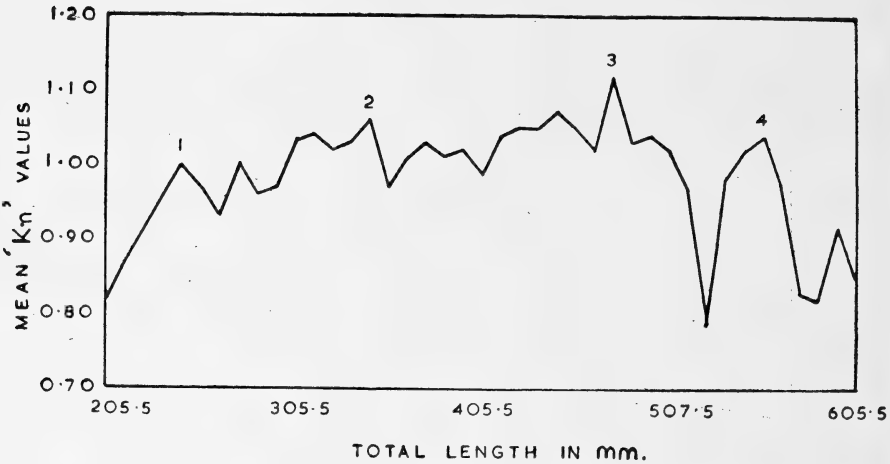
according to the length-weight relationship. In the present study the '$K_n$' values were calculated using this modified **formula.**




Text-Fig. 7. Length-weight relationship of *T. sona*

(*a*) Scatter diagram of absolute values.
(*b*) Log-log—transformation.

From the variations in the ' $K_n$ ' values at different lengths as shown in Figure 8, it appears that the fish spawns for the first time when it is




Text-Fig. 8. Mean ' Kn ' values at different lengths of *T. sona*.

about 240 mm. in length that is in the second year of its life. Subsequent spawnings take place when the fish attains the lengths of about 345, 475, and 525 mm. i.e. in the 3rd, 4th, and 5th year of its life.

## Summary

Age determination of *T. sona* was made from the zones on the vertebrae. The back-calculated lengths of each year class were used to study the growth of fish and to show the accuracy of back calculations. The results were compared with the length frequency histograms. A close agreement was obtained between observed and back calculated lengths. The age-length data were used to estimate the growth parameters of the von Bertalanffy growth equation. Length-weight relationship of the fish was determined and the fluctuations in the condition factor (k) which probably correspond to the spawning were noticed.

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# Algae of Alibag, Maharashtra

BY

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(*With a map*)

In this paper 221 taxa belonging to five classes—Chlorophyceae, Charophyceae, Euglenophyceae, Chrysophyceae, and Cyanophyceae are recorded.

In this paper freshwater and brackish water algae collected in October 1960 from different places in the central and northern parts of Alibag Taluka are recorded.

Alibag Taluka, in Kolaba District, Maharashtra State, lies on the western coast of India. The geology is essentially that of the Deccan Trap formations. The average yearly rainfall is slightly over 200 cm. The minimum and maximum temperatures recorded for the year 1960 were 62°F. in January and 95°F. in May. All the places of collection lie at mean sea-level.

The collections were made from brackish water in khar paddy fields and from fresh water. The khar paddy fields were reclaimed in the year 1870 from a large belt of salt marsh and mangrove swamps between Rewas and Shahabaj. This land is known as Kharepat or salt lands, and the paddy fields are known as khar paddy fields. They yield a very good crop of rice. Sea water encroaches on the whole of the reclaimed land at least two or three times during the monsoon. As these paddy-fields are never ploughed, there is a luxuriant algal growth. The dominant alga of these paddy fields is *Chara zeylanica* Willd. locally known as *kushya har* (a garland of bristles). The alga is a troublesome weed. The planktonic alga *Rhizoclonium hieroglyphicum* (Agardh) Kuetz. is also common.

The freshwater collection areas were ponds, pools, and paddy fields. Every village had at least one pond. Most of these ponds are being used for breeding freshwater fishes for the last four to five years. These are mainly plankton-feeders. It is noteworthy that the richest yield of fishes was in a pond at Kihim, where the algal flora was also richest. Almost every pond had two to three members of *Chara* and/or *Nitella*. The paddy fields invariably had *Gloeotrichia raciborskii* Wol. The small pools on the way-side contain a large amount of organic matter,

the dung of buffaloes which visit these pools at noon and remain in them for a long time constantly disturbing the water. These pools, locally known as *bodhans*, contain plankton usually Euglenophyceae.

So far only four algae, *Spirogyra moebii* Trans. (Syn. *Spirogyra bimorphis* Dixit), *Nitella tenuissima* Kuetz. v. *byssoides* **Braun,** *N. furcata* Agardh, and *chara brachypus* **Braun** collected from a pond at Alibag in August have been recorded by Dixit (1937, 1940)[1].


## Acknowledgements

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## Chlorophyceae

1. **Gonium pectorale** Muell.
   In a puddle, Mapgaon.

2. **Pandorina morum** (Muell.) Bory
   In pools, Zirad, Shahabaj.

3. **Gloeocystis gigas** (Kuetz.) Lager.
   In a pond, Kihim.

4. **Ulothrix aequalis** Kuetz.
   In a puddle, Tinvira.

5. **Stigeoclonium tenue** (Agardh) Kuetz.
   In a pond, Dhokavade.

6. **Chaetophora elegans** (Roth) Agardh
   Adhering to stones in a paddy field outlet, Hashivare.

7. **C. pisciformis** (Roth) Agardh
   Common. In paddy fields and streamlets.

8. **Coleochaete irregularis** Prings.
   Epiphytic on *Nitella* sp. in a pond, Kihim.

9. **C. orbicularis** Prings.
   Epiphytic on *Nitella* sp. in a pond, Kihim.

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[1] Dixit, S. C. (1937) : The Chlorophyceae of the Bombay Presidency, India—I. *Proc. Indian Acad. Sci.* B. **5** (1): 16-25; The Charophytes of the Bombay Presidency II, *J. Indian Bot. Soc.* **18** : 231-239 (1940).

10. **Protococcus viridis** Agardh
On leaves of *Sapota* sp., *Mangifera* sp. and on moist earthen pots.

11. **Enteromorpha prolifera** Agardh
Attached to stones in a streamlet, Saral. Filaments are very long.

12. **Cladophora glomerata** (L.) Kuetz.
Attached to stones in a streamlet, Saral.

13. **Pithophora oedogonia** (Mont.) Wittr.
In a well, Poynad.

14. **Rhizoclonium hieroglyphicum** (Agardh) Kuetz.
Planktonic in khar paddy fields.

15. **Oedogonium ahlstrandii** Wittr. ex Hirn
Epiphytic on *Chara* sp. in a pond, Kihim.

16. **O. anomalum** Hirn
In a pool in a streamlet, Mapgaon.

17. **O. flexuosum** Hirn
In a slightly brackish water pond, Koproli.

18. **O. pratense** Trans.
In a pool, Saral.

19. **O. subsexangulare** Tiff.
Epiphytic on *Chara* in a pond, Kihim.

20. **O. tapeinosporum** Wittr. ex Hirn
Attached to submerged cement walls in a pond, Mapgaon. The alga is slightly smaller than the type in all respects.

21. **O. varians** Wittr. ex Hirn
In a pool, Saral.

22. **O. vaucherii** (Le Clerc) Al. Braun.
Epiphytic on *Chara* sp. in a pond, Kihim.

23. **O. virceburgense** Hirn
Epiphytic on *Chara* sp. in a pond, Kihim. Vegetative cells were slightly broader than the type—up to 8 $\mu$ broad.

24. **Pediastrum duplex** Meyen v. **cohaerens** Bohlin
In a pond, Dhokavade.

25. **P. duplex** Meyen v. **reticulatum** Lag.
In a pond, Thal.

26. **P. simplex** (Meyen) Lemm.
Common. In ponds, puddles.

27. **P. tetras** (Ehr.) Ralfs
Common. In ponds.

28. **P. tetras** (Ehr.) Ralfs v. **tetradron** (Corda) Rab.
In a pond, Awas.

29. **Coelastrum sphaericum** Naeg.
Common. In ponds.

30. **Zoochlorella parasitica** Brandt
Endophyte in freshwater sponges in ponds.

31. **Oocystis borgei** Snow
Common. In ponds.

32. **O. elliptica** W. West
In a pond, Thal.

33. **Dimorphococcus lunatus** A. Braun.
In a pond, Thal.

34. **Ankistrodesmus convolutus** Corda
In a pond, Awas.

35. **A. falcatus** (Corda) Ralfs
Common. In ponds.

36. **A. falcatus** (Corda) Ralfs v. **tumidus** G. S. West
In a pond, Awas.

37. **A. spiralis** (Turn.) Lemm.
In a pond, Thal.

38. **Selenastrum gracile** Reinsch
In a pond, Dhokavade.

39. **Tetraedron trigonum** (Naeg.) Hansg.
In Khar paddy fields, Rewas.

40. **Scenedesmus arcuatus** Lemm. v. **platydiscus** G. M. Smith
In a pond, Awas.

41. **S. bijuga** (Turp.) Lag.
Common. In ponds.

42. **S. denticulatus** Lag.
In a pond, Awas.

43. **S. falcatus** Chodat
In a pond, Dhokavade.

44. **S. incrassatulus** Bohlin v. **momonae** G. M. Smith
On a dam, Tinvira.

45. **S. opoliensis** P. Richter
In a pond, Dhokavade.

46. **Micractinium pusillum** Fres.
In a pond, Dhokavade.

47. **Botryococcus braunii** Kuetz.
In a pond, Dhokavade.

48. **Roya cambrica** W. et G. S. West
In a pond, Thal.

49. **Pleurotaenium elatum** (Turn.) Borge v. **subundulatum** Hir.
In a pond, Mapgaon.

50. **P. simplicissimum** Gron. v. **semiundatum** Hir.
In a pond, Dhokavade.

51. **P. subcoronulatum** (Turn.) W. et G. S. West
In a pond, Thal.

52. **P. trabecula** (Ehr.) Naeg.
In a paddy field, Saral.

53. **Closterium acutum** Breb.
In a pond, Thal.

54. **C. cornu** Ehr.
In a pond, Poynad.

55. **C. dianae** Ehr.
In a pond, Thal.

56. **C. dianae** Ehr. v. **minus** (Wille) Schred.
In a pond, Thal.

57. **C. gracile** Breb.
In a pond, Thal.

58. **C. gracile** Breb. v. **intermedium** Irenee-Marie.
In a pond, Thal.

59. **C. kuetzingii** Breb.
In a pond, Thal.

60. **C. parvulum** Naeg.
In paddy fields, Saral.

61. **C. parvulum** Naeg. v. **angustum** W. et G. S. West
In a puddle, Mapgaon.

62. **C. venus** Kuetz.
In paddy fields, Saral.

63. **C. venus** Kuetz. v. **incurvum** (Breb.) Krieg.
In a pond, Kihim.

64. **Cosmarium abbreviatum** Racib. v. **pygmaeum** Mess.
In a paddy field, Saral. In a pond, Kihim.

65. **C. amoenum** Breb.
In a pond, Dhokavade.

66. **C. angulosum** Breb. v. **concinnum** (Raben.) W. et G. S. West
In a pond, Kihim.

67. **C. bengalense** (Grun.) Turn.
In a pond, Dhokavade.

68. **C. bioculatum** Breb. v. **hians** W. et G. S. West
In a pond, Awas. The alga is slightly smaller in size than the type.

69. **C. contractum** Kirch.
In a pond, Dhokavade.

70. **C. cyclicum** Lund f. **crenulatum** Kam.
In a pond, Kihim.

71. **C. depressum** (Naeg.) Lund v. **planktonicum** Rev.
In a pond, Kihim.

72. **C. furcatospermum** W. et G. S. West v. **koreanum.** Skv.
In paddy fields, Saral.

73. **C. impressulum** Elfv.
In a pond, Kihim.

74. **C. laeve** Rab.
In paddy fields, Saral.

75. **C. laeve** Rab. v. **reniforme** Hir.
In the mucilaginous masses on the dripping wall of the dam, Tinvira. In a pond, Awas.

76. **C. margaritatum** (Lund) Roy et Bisset f. **minor** (Boldt) W. et G. S. West
In a pond, Kihim.

77. **C. meneghinii** Breb.
In ponds, Awas, Kihim.

78. **C. moniliforme** (Turp.) Ralfs
In a pond, Thal.

79. **C. occultum** Schm.
In a pond, Kihim.

80. **C. perincissum** Gron. v. **ahmedabadense** Kam.
In a pond, Kihim.

81. **C. portianum** Arch.
In a pond, Kihim.

82. **C. punctulatum** Breb. v. **subpunctulatum** (Nord.) Borg.
In a paddy field, Saral.

83. **C. rectangulare** Grunn. v. **africanum** W. et G. S. West
In a pond, Kihim.
The alga is slightly longer than the type.

84. **C. reniforme** (Ralfs) Arch. v. **compressum** Nord.
In a pond, Kihim.

85. **C. sikhimense** Turn.
In a pond, Kihim.

86. **C. subtumidum** Nord. v. **klebsii** (Gutw.) W. et G. S. West
In a pond, Kihim.

87. **C. subturgidum** (Turn.) Schm. f. **minor** Schm.
In a pond, Thal.

88. **C. tithophorum** Nord. v. **minor** Rac.
In a pond, Thal.

89. **Euastrum denticulatum** (Kirch.) Gay v. **rectangulare** W. et G. S. West
In a pond, Kihim.

90. **E. dubicum** Naeg. v. **tritum** W. et G. S. West
In a pond, Thal.

91. **E. irregulare** Gonz. et Gang.
On Tinvira dam.

92. **E. spinulosum** Delp
On Tinvira dam.

93. **E. subalpinum** Messik.
In a pond, Dhokavade.

94. **E. substellatum** Nord.
In a pond, Kihim.

95. **Micrasterias pinnatifida** (Kuetz.) Ralfs
In a pond, Dhokavade.

96. **M. zeylanica** Fritsch
In a pond, Thal.

97. **Staurastrum dejectum** Breb.
In a pond, Thal.

98. **S. dickiei** Ralfs v. **circulare** Turn.
In a pond, Thal.

99. **S. lappomicum** (Schm.) Gronb.
In a pond, Dhokavade.

100. **S. oxyacanthum** Arch.
In a pond, Thal.

101. **Desmidium aptogonum** Breb. v. **ehrenbergii** Kuetz.
In a pond, Mapgaon.

102. **Hyalotheca dissiliens** (Sm.) Breb. v. **tatrica** Rac.
In a pond, Mapgaon.

103. **Sphaerozoma granulatus** Roy et Bisset
In a pond, Thal.

104. **Zygnema czurdae** Randh.
In a paddy field, Saral.

105. **Z. gangeticum** Rao
Adhering to stones or free floating in a streamlet, Tinvira. The zygospores were completely mature and agree with the description of the type.

106. **Z. hypnosporum** Rich.
Planktonic in paddy fields on hills, Saral. The alga has been observed only in the vegetative condition—the aplanospores were not observed. Filaments with sheath were 60-70 $\mu$ broad. Many 2-celled pieces enclosed in the sheath were present.

107. **Spirogyra daedaloides** Czurda
Floating masses in a pond, Kihim.

108. **S. hyalina** Cleve
Common. In pools, paddy fields.

109. **S. hymerae** Britt. et Smith
In a pond, Mapgaon.

110. **S. singularis** Nord.
In a streamlet, Saral.

111. **Sirogonium hui** (Li) Trans.
In a puddle, Mapgaon.

112. **S. ventersicum** Trans.
Floating masses in paddy fields, Saral.

CHAROPHYCEAE

113. **Nitella acuminata** A. Braun
Common. In ponds, Awas, Zirad, Kihim, Thal.

114. **N. axillaris** Braun.
In a pond, Kihim.

115. **N. furcata** (Roxb. apud Bruz.) Agardh
In ponds, Kihim, Awas.

116. **N. hyalina** (DC.) Agardh
Very common. The alga is found in Khar paddy fields and in many ponds.

117. **N. wattii** J. Grov.
In a pond, Mapgaon.

118. **Chara benthamii** A. Braun
In a pond, Kihim.

119. **C. brachypus** Braun
Common in ponds, paddy fields.

120. **C. corallina** Willd.
Common in ponds.

121. **C. pseudobrachypus** Grov. et Steph.
In ponds, Saral, Awas.

122. **C. zeylanica** Willd.
Very common and a very variable species. In Khar paddy fields, ponds, pools, paddy fields.

## EUGLENOPHYCEAE

123. **Euglena acus** Ehr.
Common in *bodhans*.

124. **E. gracilis** Klebs
Common in *bodhans*.

125. **E. proxima** Dang.
In a *bodhan*, Koproli.

126. **Phacus acuminatus** Stok.
In ponds, Thal, Awas.

127. **P. acuminatus** Stok. v. **triqueter** Skv.
In a pond, Dhokavade.

128. **P. brachykentron** Poch.
In a *bodhan*, Shahabaj.

129. **P. caudatus** Hueb.
In a pond, Awas.

130. **P. helicoides** Poch.
In ponds, Awas, Thal.

131. **P. longicauda** (E.) Duj.
In a pond, Thal.

132. **P. meson** Poch.
In a pond, Mapgaon.
The alga is broader than the type—up to 55 $\mu$ broad.

133. **P. orbicularis** Hueb.
In a pond, Dhokavade.

134. **Lepocinclis acuta** Pres.
In a pond, Thal.

135. **L. ovum** (Ehr.) Lemm.
In a pond, Awas.

136. **L. ovum** (Ehr.) Lemm. v. **dimidio-minor** Defl.
In a pond, Awas.

137. **Trachelomonas armata** (Ehr.) Stein v. **steinii** Lemm. emend. Defl.
In a *bodhan*, Koproli.

138. **T. bulla** Stein emend. Defl.
In a pond, Dhokavade.

139. **T. klebsii** Defl.
In paddy fields, Rewas.

140. **T. oblonga** Lemm. v. **truncata** Lemm.
In a *bodhan*, Zirad.

141. **T. scabra** Playf.
In a *bodhan*, Koproli.

142. **T. volvocina** Ehr.
Common. In *bodhans* and ponds.

143. **T. volvocina** Ehr. v. **punctata** Playf.
In a pond, Mapgaon.

144. **T. woycikii** Kocz.
In a pond, Thal.

### Chrysophyceae

145. **Ophiocytium cochleare** (Eichw.) A. Braun
In a pond, Awas.

## Cyanophyceae

146. **Microcystis aeruginosa** Kuetz.
Common. In puddles, ponds.

147. **M. flos-aquae** (Wittr.) Kirch.
In pools, ponds, Thal, Alibag, Poynad.

148. **Aphanocapsa koordersi** Ström
Floating or submerged masses in khar paddy fields, Rewas.

149. **A. roseana** de Bary
In paddy fields, Zirad.

150. **Aphanothece castegnei** (Breb.) Rab.
Floating masses in paddy fields, Zirad.

151. **A. microscopica** Naeg.
Common. Planktonic in paddy fields, ponds.

152. **A. pallida** (Kuetz.) Rab.
Very common. On moist soils, paddy fields, khar paddy fields.

153. **Chroococcus tenax** (Kirch.) Hieron
In paddy fields, Saral, Zirad.

154. **C. turgidus** (Kuetz.) Naeg.
Rare. In paddy fields, Saral.

155. **Merismopedia glauca** (Ehr.) Naeg.
In a brackish water pond, Koproli.

156. **M. tenuissima** Lemm.
In a pond, Awas.

157. **M. punctata** Meyen
In a pond, Koproli.

158. **Calothrix clavatoides** Ghose
Embedded in the mucilaginous masses of *Gloeotrichia* sp. floating in a paddy field, Saral.

159. **C. columbiana** G. S. West v. **constricta** Gonz. et Kam.
Embedded in the mucilaginous masses of *Gloeotrichia* sp. in a paddy field, Saral.

160. **C. fusca** (Kuetz) Born. et Flah. v. **crassa** C. S. Rao

Adhering to stones in a streamlet, Alibag.

161. **C. karnatakensis** Gonz. et Kam.

Embedded in the mucilaginous masses of *Gloeotrichia* sp. in a paddy field, Thal.

162. **Gloeotrichia natans** Rab. ex Born. et Flah.

In a paddy field, Poynad.

163. **G. pilgeri** Schm.

Attached to aquatic plants in a pond, Dhokavade.

164. **G. raciborskii** Wol.

Very common. In paddy fields, ponds.

165. **G. raciborskii** Wol. v. **salsettense** Dixit

In a pond, Awas.

Vegetative cells were broader than those in the type—up to 13$\mu$ broad.

166. **Microchaete uberrima** N. Carter

In paddy fields, Saral.

167. **Fortiea bossei** (Fremy) Desik. v. **indica** Kam.

Attached to the dam wall, Tinvira.

168. **Aulosira fertilissima** Ghose v. **tenuis** C. B. Rao

Common. In paddy fields, pools, ponds.

169. **A. implexa** Born. et Flah. v. **crassa** Dixit

In a mountain streamlet, Saral. In paddy fields, Saral, Kihim.

170. **Hapalosiphon luteolus** W. et G. S. West

Rare. In a pond, Thal.

171. **H. welwitschii** W. et G. S. West

Embedded in the mucilaginous masses of *Chaetophora* sp., floating in paddy field, Zirad. The heterocysts were not rare. They were longer than those of the type—up to 15$\mu$ long. The spores were observed to germinate *in situ*.

172. **Nodularia spumigena** Mert. ex Born. et Flah.

In khar paddy fields, Shahabaj. The vegetative cells agree with those of *N. spumigena* Mert. ex Born. et Flah. v. *major* (Kuetz.) Born. et Flah., while the spores agree with *N. spumigena*.

173. **Cylindrospermum alatospermum** F. E. Fritsch
In a paddy field, Saral. The spores in most of the filaments were next to the heterocysts, however in few cases the spores were found 4-5 cells away from the terminal heterocysts, and the cells between the heterocysts and the spores remain vegetative only.

174. **C. majus** Kuetz.
In a puddle, Saral.

175. **C. muscicola** Kuetz.
In paddy fields, Saral, Hashivare, Zirad.

176. **C. stagnale** (Kuetz.) Born. et Flah. v. **minus** Kam.
Floating or submerged masses in khar paddy fields, Rewas. The vegetative cells are slightly broader than those in the type—up to 4·3 $\mu$ broad.

177. **Anabaena fuellebornii** Schm.
In a shaded pool, Saral.

178. **A. vaginicola** Fritsch et Rich.
In a paddy field, Thal.

179. **A. volzii** Lemm.
Common. In shaded pools, ponds, paddy fields.

180. **Nostoc amplissisum** Setch.
On a dam, Tinvira.

181. **N. piscinale** Kuetz.
In puddles, streamlets, Saral.

182. **Scytonema coactile** Mont. v. **minus** Wille
Planktonic in khar paddy fields, Hashivare.

183. **S. myochrous** (Dillw.) Ag.
Attached to the wall of the dam, Tinvira.

184. **S. stuposum** (Kuetz.) Born.
In a pond, Dhokavade.

185. **Petalonema alatum** Berk.
Attached to the wall of the dam, Tinvira.

186. **Spirulina labyrinthiformis** Gom.
In a brackish water pool, Koproli ; in khar paddy fields, Rewas.

187. **S. meneghiniana** Zan.
Common. In paddy fields—freshwater and khar both.

188. **S. princeps** W. et G. S. West
In a pond, Thal.

189. **Oscillatoria amphibia** Agardh ex Gom.
In a brackish water outlet, Rewas.

190. **O. annae** van Goor
In khar paddy fields, Poynad.

191. **O. brevis** (Kuetz.) Gom. v. **neapolitana** (Kuetz.) Gom.
In a brackish water outlet, Rewas.

192. **O. chalybea** (Mer.) Gom. v. **minor** Kam.
In a gutter, Saral.

193. **O. claricentrosa** Gard.
In a brackish water outlet, Rewas. End-cells were with calyptra.

194. **O. earlei** Gard.
In a paddy field, Saral.

195. **O. formosa** Bory ex Gom.
In a paddy field, Zirad ; On the dam wall, Tinvira.

196. **O. limosa** Agardh ex Gom.
In a brackish water outlet, Rewas. Calyptera was not present.

197. **O. mougeotii** Kuetz.
Planktonic in a *bodhan*, Koproli.

198. **O. pseudogeminata** G. Schmid
In a khar paddy field, Rewas.

199. **O. pseudogeminata** G. Schmid v. **unigranulata** Biswas
Planktonic in a *bodhan*, Thal.

200. **O. quadripunctulata** Bruehl et Biswas
In a brackish water outlet, Rewas.

201. **O. quadripunctulata** Bruehl et Biswas v. **unigranulata** Singh
In the mucilaginous masses of *Gloeotrichia* sp. floating in a paddy field, Thal.

202. **O. rubescens** D. C. ex Gom. f. **ahmedabadensis** Kam.
On moist soil near a gutter, Saral.

203. **O. schultzii** Lemm. v. **cyclindrica** Kam.
In a gutter, Saral.

204. **Lyngbya aerugineo-coerulea** (Kuetz.) Gom.
In the mucilaginous masses of *Aphanothece* sp. floating in a paddy field, Mapgaon. Calyptra is absent.

205. **L. allorgei** Fremy
In a pond, Dhokavade.

206. **L. confervoides** Agardh ex Gom.
In a khar paddy field, Shahabaj.

207. **L. dendrobia** Bruehl et Biswas
In a paddy field and in a fast running streamlet, Saral.

208. **L. digueti** Gom.
In a khar paddy field, Rewas.

209. **L. maior** Mene. ex Gom.
In a pond, Poynad.

210. **L. majuscula** Harvey ex Gom.
In a pond, Saral.

211. **L. palmarum** (Mert.) Bruehl et Biswas
On stones in a fast running streamlet, Saral.

212. **L. perelegans** Lemm.
In a khar paddy field, Rewas.

213. **L. polysiphoniae** Fremy
In a streamlet, Saral.

214. **L. semiplena** (Agard C. A.) J. Ag. ex Gom.
In a puddle, paddy fields, Koproli, Saral.

215. **L. shackletoni** W. et G. S. West
In a *bodhan*, Satghar.

216. **Symploca muscorum** (Agardh) Gom.
On moist soil near a well, Saral. Trichomes were of smaller size—up to 4·5 $\mu$ broad only.

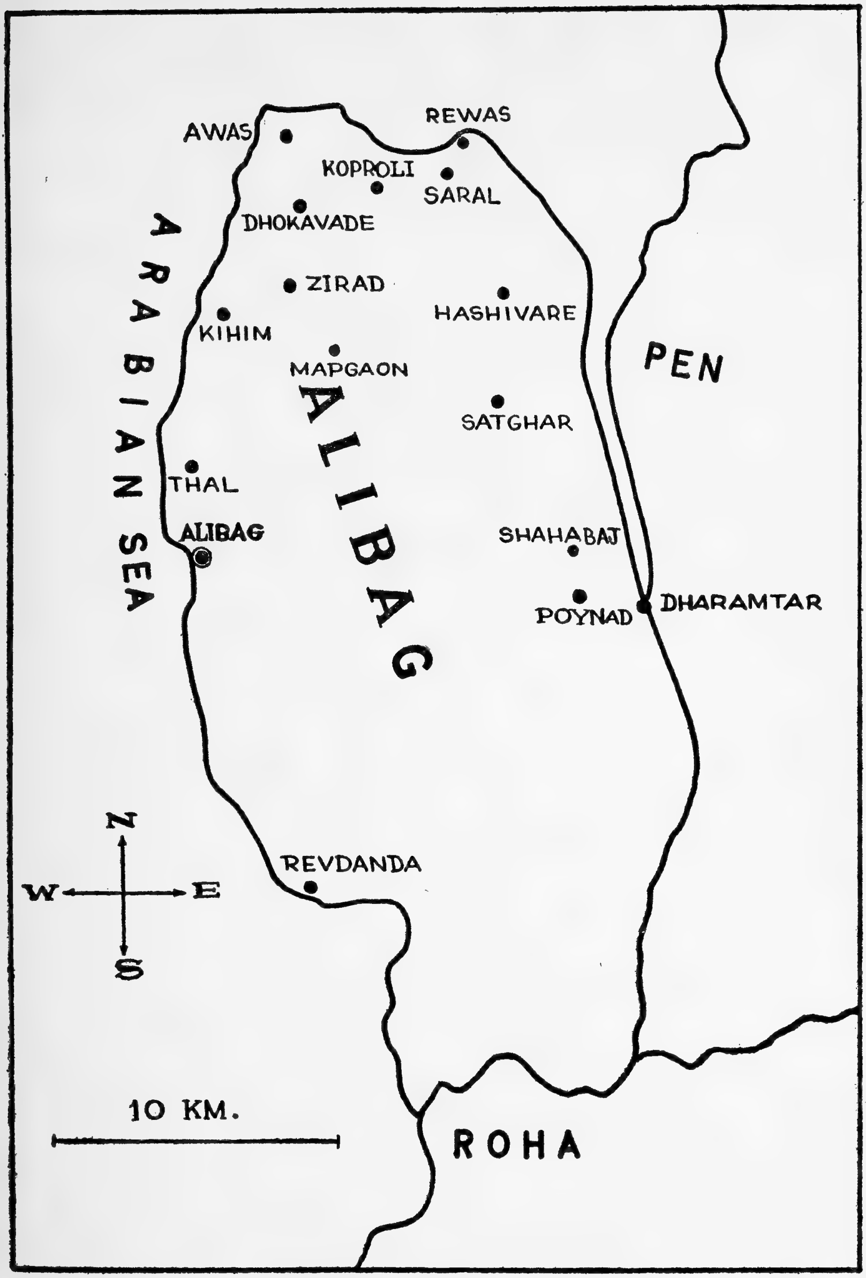
217. **Polychlamydum insigne** W. et G. S. West
Planktonic in khar paddy fields, Rewas, Shahabaj.

218. **Microcoleus chthonoplastes** Thuret ex Gom.
In paddy fields, Saral, Zirad.

219. **M. steenstrupii** Boye-Pet. f. **attenuata** Kam.
In paddy fields, Rewas.

220. **Schizothrix mexicana** Gom.
On stones in a fast running streamlet, Saral.

221. **S. porphyromelana** (Bruehl et Biswas) Geitler
In a fast running streamlet, Zirad.




Map ot Alibag Taluka, Maharashtra, showing localities of collection.

# The Biology of the Whitewinged Grosbeak, *Mycerobas carnipes* Hodgson, in Kazakhstan

BY

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(*With six plates and a text-figure*)

(*Communicated by Dr. Sálim Ali*)

## INTRODUCTION

The Whitewinged Grosbeak is a common bird of the subalpine belt of mountain ranges in the upper Mekong and Yangtze, of the ranges of Central Asia, the Himalayas, mountains of Kashmir, Afghanistan, Northern Iran, the Kopet Dagh and the Big Balkans, the Pamiro-Alai and the Tien Shan ; it is considerably less common in Saur and occurs only rarely in the Altai (it was found in February 1954 in the upper Biya tributaries ; Ternovsky 1956). Though the distribution and occurrence of this bird is rather wide and in some places the species is quite numerous, its distribution, and especially its ecology, have not been investigated thoroughly. Very little knowledge has been obtained concerning its breeding biology, e.g. about the characteristic biotopes, nest sites, period of laying, time of hatching, and other aspects of its life in the period of reproduction.

The authors were able to follow some aspects of the nesting biology of this species while working in the Zailiysky Alatau. Observations were made in 1964-65 in the area of the Big Almatinsky Lake (2500 m.[1]) ; in addition the observations which had been made some time before in different gorges of the Zailiysky Alatau and in the Saur have been used in the paper. The authors have also collated information found in the literature for nearby localities.

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[1] Here and further on it means height above sea-level.

## Habitat and Numbers

In the Zailiysky Alatau the Whitewinged Grosbeak is a rather common bird, while in some appropriate localities it can be considered even numerous. During the nesting season the distribution of this bird is closely related to the occurrence of juniper (*Juniperus*); the ranges of distribution of all the species of this plant (*J. turkestanica, J. sibirica*[1]) represent the range of the Whitewinged Grosbeak as well. The relations of this species with the juniper are exceedingly close. This has always been stressed by every naturalist, and we in our turn confirm this fact. The number of the Whitewinged Grosbeaks depends on the area occupied by the juniper. The species is most numerous in the belt of maximum growth of the juniper, i.e. at an elevation of 2600-2900 m. (Plate I). Still higher, where juniper thickets become sparse, the number of the Whitewinged Grosbeak is considerably less, but it still occurs up to the last shrubs of juniper, i.e. under conditions of the Zailiysky Alatau—up to 3100-3200 m. On May 31, 1965, we twice met single birds above 3500 m. where they were in company with the Redbreasted Rosefinch (*Pyrrhospiza punicea*). Most probably the birds were feeding on other plant seeds there as no juniper shrubs were present. The lower limit of nesting of the Whitewinged Grosbeak is also determined by the lower limit of the juniper. In the Big Almatinska gorge, isolated clumps of juniper can be found deep down the canyons, in the middle belt among the spruces growing at an altitude of about 2200 m. Individual pairs of this species nest in these, so probably this height may be considered the lower limit of the nesting of this bird. Thus, the vertical breeding range of the Whitewinged Grosbeak in the Zailiysky Alatau lies between 2200 and 3200 m.

The number of nesting birds in this range varies. At an altitude of 2200-2400 m. it is a very rare bird occurring as individual pairs near isolated clumps of juniper bushes. At an altitude of 2400-2600 m. the Whitewinged Grosbeak becomes quite common and is distributed more or less evenly coincident with the wide distribution of juniper thickets. At altitudes of 2600-2900 m., in the region of predominance of juniper thickets on the hillsides of southern and related exposures, the Whitewinged Grosbeak is very numerous, being as a rule, the most numerous of all the birds inhabiting the juniper growth. Higher up its numbers decrease again, while on the boundaries of the juniper zone the bird is very rare.

At altitudes of 2600-2700 m. the spruce (*Picea schrenkiana*) grows both as separate trees and in groups among the junipers, while below 2600 m. the juniper growth has a subordinate role : here the fir-wood

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[1] In the vicinity of the Big Almatinsky Lake there is no arborescent juniper.

Dolgushin : Whitewinged Grosbeak

Nesting site of the Whitewinged Grosbeak. Juniper thickets.

(*Photo : E. Gavrilov*)

Dolgushin : Whitewinged Grosbeak

Nesting site of the Whitewinged Grosbeak. Upper boundary of fir-wood.

(*Photo : E. Gavrilov*)

formation is predominant (Plate II). In the belt of coniferous forest the juniper grows mostly on the bare southern versants, in clearings as well as in areas of thin forest. Under conditions of rugged topography of various assemblies of versants of different exposure the distribution of any plant association is of a very complicated nature. It should be noted that the presence of the spruce does not influence distribution of the Whitewinged Grosbeak and its population density, because its numbers in the optimum range of junipers is the same both in pure juniper stands and in juniper forest mixed with fir-wood (or in fir-wood mixed with juniper).

The following feature is very characteristic of the number of Whitewinged Grosbeak. On the southern versant of the ridge, two kilometres in length at its relative elevation exceeding 200-250 m., about 20 to 25 pairs of this species were nesting. This was a site of almost pure juniper growth ; only in one place there was a group of 15 spruces. The same density was observed in another area occupied by fir and juniper in approximately equal proportions.

Analogous distribution of the Whitewinged Grosbeak was observed on other ridges of the Tien Shan. On the Dzhungar, Terskey and Ketmen ridges the maximum number was noted in the juniper-spruce belt (Koreev & Zarudny 1906, Stepanyan 1956, Korelov 1956). On the Kirghiz ridge the Whitewinged Grosbeak mainly inhabits the zone of arborescent juniper (*Juniperus semiglobosa, J. zeravschanica*) at elevations of 1800 to 2400 m. (Kuznetsov 1962). In the Talass ridge this bird mainly inhabits the zone of creeping juniper (*J. turkestanica*), while below, in the thickets of arborescent juniper, it is very rare (Kovsharj 1966).

## Field Characteristics and Food

The Whitewinged Grosbeak is one of the largest representatives of the family Fringillidae. It is the size of a starling, but with a longer tail and the body set lower. The front and the tail of the adult male are black, its abdomen and tail-coverts are yellow-green. The remiges are dark brown with narrow greenish-yellow edges, and on its wing there is a small white speculum. The female has the same coloration, but instead of black it is dark grey.

15 males measure : wing 109-124 mm. (mean 115 mm.) ; tail 97-121 mm. (mean 104 mm.) ; bill length 15·2-19·7 mm. (mean 17 mm.) ; bill height[1] 15·2-17·8 mm. (mean 16·7 mm.) ; weight (11 specimens) 56-63 gm. (mean 59·7 gm.).

18 females measure : wing 109-120 mm. (mean 114·4 mm.) ; tail 82-118 mm. (mean 102·8 mm.) ; bill length 13·8-17·7 mm. (mean

[1] On the level of the front edge of the nostrils.

15·0 mm.); bill height 14·2-17·0 mm. (mean 14·7 mm.); weight (14 specimens) 50·5-66·0 gm. (mean 58·2 gm.).

The Tien Shan is inhabited by the subspecies *M. c. merzbacheri* Schalow (Keve 1954; Stepanyan 1964).

The flight of this bird is very fast and undulating. On the ground it moves in hops. Its voice is coarse, loud and far-carrying. The sound may be transcribed as *che-gah-gah, che-gah-gah.* It is not too shy, and while feeding in a juniper bush may be approached within 3 to 5 metres.

From external appearance, the Whitewinged Grosbeak is a typical granivorous bird. Visual observations, analysis of the stomach and gullet contents, as well as its close attachment to juniper thickets show an extremely narrow food specialization. It is enough to say that during the whole year the staple food of the birds is just the seeds of juniper. The abundant fruit-bearing of this plant and slow ripening of the seeds (up to two years) ensure a constant food supply for the Whitewinged Grosbeak during the entire year. Although juniper fruits may be eaten by other birds too (thrushes, Alpine Chough, etc.), it is only the White-winged Grosbeak with its powerful bill that can utilise the juniper seeds easily cracking the thick seed coat. The great quantity of fruits borne on a single bush makes it possible for the birds to feed in one place for a long time. As a result, the ground under the bush becomes thickly strewn with the fruit meat and shells of juniper seeds.

L. M. Shulpin (1953) described the feeding of the Whitewinged Grosbeak as follows: '.... it opens its beak not very wide, owing to sharp ends it bites the fruit from its side; the bird thrusts its beak into the meat and with sharp edge of the jaws simultaneously assisted by the very peculiar spoonlike tongue, very quickly cleans the stone from meat and shell which fall on the ground. The sides of the under half of the bill are thick, with a swelling at the base; the size of the thick part is almost as thick as a pea, its upper part is flat and covered with parallel small ribs, like notches. On the upper half of the bill there is a special corresponding swelling. As a result it looks something like a pliers, on which the stone is fed by the spoonlike surface of the tongue, and crushed by the strength of the large jaw muscles, although the stone may be very hard. The convenience and force of this mechanism are evident when we consider that this stone cannot be split by human teeth, besides it slips easily off the teeth'.

In fall and winter, the birds descend to the lower mountain belts, where they have to eat other food as there are no thickets of juniper. In the middle belt of fir-wood the Whitewinged Grosbeak enjoys fruits of the mountain ash; even the young birds whose bills are still not strong enough can split the seeds. It is known that the Whitewinged Grosbeak can also eat spruce seeds after extracting them from the cones. In the zone of deciduous forest the birds feed on the seeds of rose and haw-

thorn ; they may also peck the apples remaining on the trees and extract their seeds. On the xerophyte mountains in winter, the Whitewinged Grosbeak feeds on seeds of the Persian parrotia (*Celtis caucasica*), mountain cherry (*Cerasus* sp.)., and rose. It eats only the fruit-stones of these plants, discarding the juicy pulp of the fruits and berries.

Whitewinged Grosbeaks feed their nestlings mainly with juniper seeds ; most probably they bring these seeds in their mouth and not in the ' craw '[1], as before feeding them to the nestling they do not produce any regurgitating movements typical of other finches. However, on the whole, they feed their young, like all other finches, with mixed food, though animal food plays an insignificant role in their diet. In the stomachs of five nestlings, besides juniper seeds, there were found beetles (Curculionidae) in all five, larvae of Orthoptera in one, an egg pouch of Orthoptera in one, larva of a leafhopper in one, molluscs in three stomachs.

## Breeding Biology

The time of pair formation in the Whitewinged Grosbeak is unknown. From the beginning of April the majority of the birds could be seen in pairs. Although flocks of 10,18 and 16 individuals were seen on 10, 17 and 22 April respectively, it was evident that birds in these flocks were in pairs.

On April 13 and 18 several fights between individual Whitewinged Grosbeaks were observed. It is quite probable that these conflicts occur when the birds are occupying nesting sites.

Unlike many finches, Whitewinged Grosbeaks do not exhibit any vocal ability. The song of the male is very simple and short, merely a low chirping and melodious piping. It is not very often that their singing is heard ; we heard it only twice : August 14, 1964 and April 1, 1965.

We succeeded in discovering 28 occupied and 27 old nests of the Whitewinged Grosbeak. 36 of them (65%) were built on spruce trees and 19 (35%) on junipers ; we failed to find their nests on other bushes (mountain ash, honeysuckle, etc.). It may thus be assumed that the species builds its nest with equal facility both on the juniper and on the spruce. The figures given above are too small for generalizing about the preferential selection of the spruce for its nest site, and it is quite probable that chance plays an important part in this.

The nests in juniper were built 0·6 to 1·8 m. above the ground, averaging 1·2 m. (ten measurements) ; and 20 to 70 cms. below the bush tops. The majority of nests are very well covered by the foliage and

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[1] The ' craw ' in passerines is a small enlargement of the gullet.

hidden from all sides. Only one nest was built in such a way that it could be seen from 12 m. down below in the gorge.

The spruce trees with nests were of various sizes. The height of 34 observed nest trees, varied from 0·6 to 20 m., averaging 6·3 m. The nests were built 0·4-14·5 m. above the ground (average 3·2 m.). In most cases the nests were built on small spruces 2·5-5·0 m. tall ; however three nests were found quite high above the ground. One was in a spruce 20 m. high, and built 14·5 m. above the ground ; the second was built on an inclined tree 12-13 m. from base and 1·5-2·0 m. below its top ; the third one was built 12-14 m. above ground and 4 m. from the tree top.

The nests in the spruce trees were built both near the trunk as well as out on the boughs. Of 28 nests 18 (64%) were built near the trunk, and 10 (36%) on the boughs 5 to 200 cm. from the trunk (mean 60 cm.). The majority of the nests (88·5%) were situated on the southern side of the trunk. Of 26 nests, 14 were on the southern side, 7 on the south-western side, 2 on the south-eastern side, 1 on the eastern, and one on the north-eastern sides.

The nests consist of two layers. The outer layer is made of various materials such as twigs of spruce trees, juniper, spireas, honeysuckle, and of the last year stems of different herbs ; sometimes elongated dry leaves were interwoven in the nest. As a rule, the twigs used for nest base are comparatively slender, usually 2 to 4 mm. thick or a little thicker. Twigs of the spruce have been observed only in the nests built in spruce trees, while twigs of juniper and other brushwood could be observed in all nests. The external layer may consist either of twigs only, or mainly of dry grass, or it may consist of both of these materials in approximately equal quantities. In three nests some green moss was found in the external layer.

In every nest we found that the inner layer consisted exclusively of thin strips of juniper bark and bast fibre, which were rather long (up to 30 cm., usually from 10 to 15 cm.) and wide (up to 1·5 cm., usually from 0·3 to 1 cm.). This layer of strips of juniper bast represented essentially the lining of the cup ; there was neither grass nor wool mixed in it. Only in one nest we found that besides juniper bast there were a few pieces of moss. This structure enables nests of the Whitewinged Grosbeak to be distinguished from the nests of all other birds nesting in the Tien Shan mountains.

Measurements made of 15 nests were very similar. The smallest nest was 122 mm. in diameter, the largest one 200 mm. (mean 163 mm.). The diameters of the nest-cups ranged from 70 to 90 mm. (mean diameter 81 mm.). Most of the nests had a cup of a very regular round shape, and only few nests being squeezed between the branches had oval cups. Thickness of the nest 71 to 120 mm. (mean 95 mm.) ; depth of the cup 40 to 70 mm. (average 57 mm.).

Thus, nests of the Whitewinged Grosbeak in their shape and structure resemble those of a medium type nest of finches ; their cups are quite deep. The nests are 'cold', and without any lining of animal hair or wool or bird feathers. These factors, as we shall see later, are very important.

The nest is built by the female alone, the male only accompanies her. When the female is busy tearing off the bark from the juniper bushes or placing the building material into the nest, the male sits on the top of a nearby juniper or the spruce tree, periodically calling in subdued tones. Only once did we observe a female building the nest when there was no male around. Moreover, this female was calling while building, which normally never happens ; females build the nest in silence. Later this nest was deserted before the eggs had been laid.

Building materials are usually gathered by the female somewhere in the neighbourhood, about 20-40 m. from the site. However some cases were observed when the female had to fly about 100 m. from her nest. The female is usually busy building in the first half of the day ; only once did we see a bird carrying a twig at 5.30 p.m. The frequency of flying to and fro with building material varies. One female was observed carrying pieces of bast five times between 9.45 a.m. and 10.00 a.m. Another flew three times between 11.00 a.m. to 11.30 a.m., putting the bast into the nest, while between 11.30 and 12.00 she flew in only once. It appears that intensity of nest-building is greatest during the morning hours ; around noon the building activity ceases. It is resumed in the afternoon though with much less intensity.

The Whitewinged Grosbeak usually begins laying two or three days after the nest has been completed. The female produces one egg every day during the morning hours. Only once did we observe a female lay her fourth egg three days after the third one. Incubation commences after the laying of the third egg ; before that the eggs in the nest remain cold and unattended.

A complete clutch consists of 3 to 5 eggs (Plate III, *above*). All the nests we found in the Zailiysky Alatau contained 3 or 4 eggs ; however in the Terskey Alatau Range two out of three nests contained 5 eggs, while in the third nest there were four eggs (Stepanyan 1956).

The eggs are smooth with a slightly glossy shell of light olive colour. On the background there are scattered bright superficial dark brown, almost black, spots, specks and commas and light violet-brown spots in depth. The superficial spots are sharply outlined, while the underlying ones have diffused margins so that the pattern on the shell looks like marble.

The size and shape of eggs are given in Table 1. The weight of unincubated eggs may be 5·4, 5·5, 5·9 and 6·1 gm., while well incubated eggs weigh *c.* 5·0 to 5·2 gm.

TABLE 1

SIZE (MM.) AND SHAPE OF EGGS OF THE WHITEWINGED GROSBEAK [1]

| | Minimum | Maximum | Mean | Number measured |
|---|---|---|---|---|
| Length .. | 25·1 | 30·0 | 27·7 | 26 |
| Width .. | 17·4 | 20·5 | 19·4 | 26 |
| Shape $\frac{\text{Width}}{\text{Length}}$ .. | 0·61 | 0·77 | 0·70 | 26 |

[1] The Table includes the size of 8 eggs given by L. S. Stepanyan (1956) for the Terskey Alatau Range.

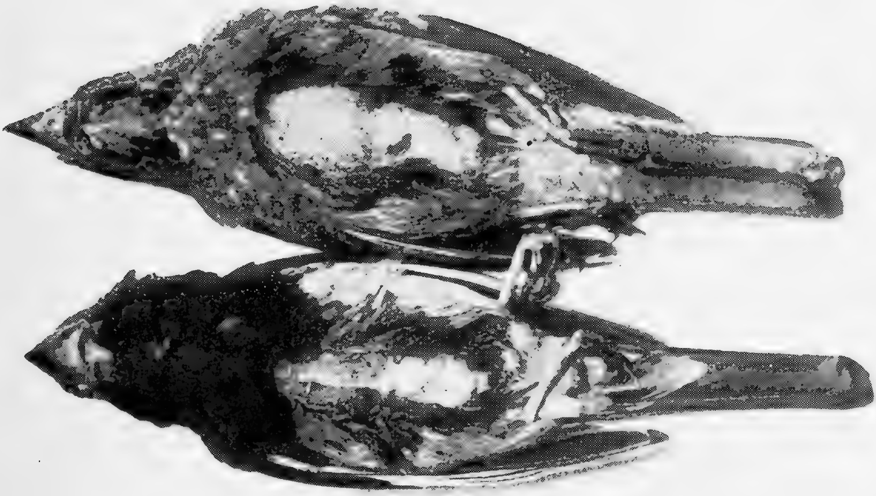
Both parents take part in incubation of the clutch. The main part however belongs to the female ; 32 out of 35 birds observed on the nests (or 91%) were females, and only 3 (or 9%) were males. It appears that there is no special time for the male to relieve the female on the nest ; we observed incubating males at 9.25 a.m., 11.00 a.m., and at 7.00 p.m. Each parent has a well developed brood patch (Plate III, *below*). In the female it is much more developed and of much bigger size than the male. We have not observed if the male feeds the female while the latter is incubating, but on two occasions (April 17, June 15) we observed the male feeding the female outside the nest.

The incubation period was established for two nests. In one the first egg was laid on June 13, while the third one appeared on June 15, and incubation started from the same day (the fourth and last egg was laid on June 16). The first egg hatched on June 30 ; the next day the nest was destroyed by a magpie. In the morning there was only one egg left, which also disappeared by midday. Thus, the first egg hatched after fifteen days of incubation. In the other nest the first egg was laid on June 14, incubation started from June 16, and after 16 days (on July 2) all eggs hatched. The observations showed that the incubation period of the Whitewinged Grosbeak is 15 or 16 days.

The young do not hatch simultaneously. Usually on the first day three chicks are hatched while the fourth one hatches on the second day. In rare cases one egg hatches on the first day, two more on the next day and the last egg only on the third day. Only one case was observed where the last egg hatched three days later than the first ones. Differences in the age of the chicks are especially marked during the first few days of life ; later on their sizes become more uniform.

The chicks are hatched blind ; according to our observations their eyes open on the third or fourth day. Their bodies are covered rather thickly with light-coloured grey down with a very peculiar tint (Plate IV, *above*), very difficult to describe or compare with anything else.

Dolgushin : Whitewinged Grosbeak



*Above :* Nest of the Whitewinged Grosbeak ; *Below :* Brood patch of a male (below) and of a female Whitewinged Grosbeak.

(*Photos : E. Gavrilov*)

Dolgushin : Whitewinged Grosbeak

*Above :* Downy chick of the Whitewinged Grosbeak 2-3 days old ; *Below :* The female feeding her chicks.

(*Photos : E. Gavrilov*)

Both the female and the male feed their young (Plate IV, *below* & Plate V). Usually the chicks are fed by both parents together ; but sometimes the food may be brought only by the female, and sometimes only by the male. According to our observations, however, the main part in foraging for the chicks is taken by the male. This is due to the fact that the female has to stay with the nestlings for rather long periods. She stays in the nest in cold weather, when it rains, and also during very hot weather and strong insolation. During these periods the male brings the food, which is partly fed to the female, who in turn partly distributes it among the chicks. The food is also partly passed directly to the young by male. But when both parents feed the chicks together they distribute it uniformly among the brood.

The intervals between the visits of the parents with food to the nest vary : there may be from ten to thirty minutes between each visit, or sometimes it may take as much as one hour. Arriving birds alight on a bush three or four metres away from the nest and then approach it gradually, hopping from branch to branch ; usually the female is the first to approach. The parents feed their young throughout the hours of daylight ; they may cease feeding them only when severe weather sets in (strong wind, fog, snow, heavy rain, etc.).

The food is collected far from the nest, often more than one kilometre away, and it is never to be found nearer than a few hundred metres away. The juniper thickets are the birds' feeding site, and also where they collect the food for their chicks. The parents fly to the wood, perch on the tops of the bushes, and the female immediately disappears into their depth. The male stays for some time perching on the top of the bush looking around. After assuring himself that there is no danger he also disappears into the thickets, but from time-to-time he mounts to the top again to reassure himself of safety. All this time the female is in the thickets. Should there be any danger, the male warns the female by calling, and in case of imminent danger both birds flush out. However, the birds are not very shy, and often allow a man to approach them within five or six metres. It is usually impossible to see the birds in the depth of the thickets from this distance. They feed in silence, but the very characteristic cracking noise of the stones of the juniper fruits in their bills, which can be heard as far as 20 to 30 metres away, betrays their presence.

Once we observed that a female, after feeding her chicks, stood with her feet on the opposite rims of the nest, dipped into it and began to pull out the lining of the cup. She would take the individual pieces of juniper bast into her beak, chew them for some time, and then return them back into the nest. A few times she picked up something from the cup. It seemed as if she was trying to clean the nest of some parasites.

Faeces of the nestlings, are as a rule eaten by their parents, mostly by the female and very seldom by the male (Plate VI, *above*). When the chicks grow bigger and produce a great deal of faeces, the birds carry part of it out of the nest and drop it 30-40 m. away.

The nestling period was observed only in one case. On July 28 there were one nestling and three eggs in the nest ; on July 29 three nestlings and one egg ; on July 30 three nestlings and one slightly punctured egg (the chick may possibly have hatched the same afternoon) ; on July 31 four nestlings. On August 11 there were only three nestlings in the nest (the fourth evidently died), while on August 15 when we examined the nest, two nestlings had already flown. In this case the nestling period was about 17 or 18 days, though it appears that normally nestlings do not leave the nest until approximately 20 days old.

It is worth noting that when the nestlings leave their nests they can only flutter about in short flights in the depth of the thickets near their nests. It appears that difference in nestling period is due to their ability to make these short flights, and at the slightest danger they leave the nest.

Thus the complete nesting cycle, from commencement of nest-building until the nestlings start their independent life, takes at least one and a half months, or rather two months.

The first flying young birds were observed in the first half of June. On August 22 we saw a brood of Whitewinged Grosbeaks which had the wing-feathers still growing. The dates for the Talass Alatau Range may be somewhat later. On September 7, 1933, L. M. Shulpin found a bird which had just left the nest ; it had a very short tail, about one-third the normal size.

### Post-nesting Period

After Whitewinged Grosbeaks leave the nest the broods still keep together for quite a long time. These broods undertake short flights in search of feeding sites. Some of them may moult as early as July, but most birds moult in August-September, completing it in October. According to the material in our collections we may infer the following about the change of the dress of this species. The hatched chicks are covered with down, which by the end of their nestling period changes into a juvenile plumage. This plumage may be kept for one or one and a half months. By the end of summer and in fall the juvenile Whitewinged Grosbeaks undergo a complete moult to their first year dress. Sexual dimorphism is not apparent in this plumage, and the young males look very much like the old females in colour. The adult dress is assumed by the young birds only after the first year is over, the moult taking place at the same time as in old birds, i.e. July-October. We have some evidence that yearling males in the 'female' dress are capable of repro-

ducing. Thus on July 10, 1965, from one pair we got a last-year male which had just commenced moulting into the adult plumage. Its skull had completely ossified, the brood patch was still bare, and the length of testes which had already commenced to reduce, was 4 mm. (the left one) and 2·5 mm.

Thus, the Whitewinged Grosbeaks put on the final dress during the second year of their life, moulting at the same time as adult birds in fall, and not in spring as had previously been assumed (Dementjev & Gladkov 1954).

After the breeding season is over, the Whitewinged Grosbeaks spend the greatest part of their time feeding in the juniper thickets. During this period we happened to observe a flock of birds roosting at night. In the evening, when it was already dark, a flock of 10 to 15 loudly calling Whitewinged Grosbeaks flew from somewhere above into the upper boundary of a spruce grove. They quickly perched by ones and twos on the tops of the spruces and being hidden in the dense crowns of the trees, at once became silent.

During snowfall, when in a number of places the juniper bushes become partly or completely covered with snow, redistribution of the Whitewinged Grosbeaks takes place. The majority of the birds concentrate on the southern exposures of the versants, where the snow depth is the least, while others descend to lower heights, into the zone of deciduous forests. Here they live among apple trees, dense thickets of roses, buckthorns and hawthorns. Only a few birds, and that not every year, may come down to the foothills. Sometimes they may be seen in the suburbs, and even in the city of Alma-Ata, about 600 m. above sea level. The birds have never been seen in the valley of the Ili River.

And yet, there are some places where the Whitewinged Grosbeaks undertake migrations over very long distances. In March of 1949, M. A. Koozmina several times saw flocks and groups of these birds on the southern versants of the Chulack range, while on December 26, 1965, Yu. N. Grachyov found a female example in the mountains of Anarhai. These zones are 150 to 200 kilometres away from the nearest nesting sites of the Whitewinged Grosbeak. Evidently these birds avoid flat areas, which are completely covered with snow in winter preferring to migrate to rugged ground, where there are always areas free of snow cover even in severe and snowy winters.

## Fecundity

We have found 11 nests with completed clutches. In five nests (45%) there were three eggs each, in 6 nests (55%) 4 eggs each ; average 3·54 eggs per nest. In five out of nine nests there were three hatched nestlings each, and in the remaining four nests, four nestlings each ; thus

on an average there were 3·44 nestlings per nest. Evidently embryonic mortality is insignificant; in any case we have never seen any unfertilized eggs or eggs with dead embryo. From two out of seven clutches two nestlings each flew, from four, three each, and only from one, four nestlings. On an average, 2·85 nestlings flew per nest. Thus, mortality of chicks in the nest is insignificant, being approximately 17%. Usually one in each clutch dies, the last chick of the brood.

On the whole nesting success in the Whitewinged Grosbeak is not very high, as clutches and nestlings are often destroyed by various agents. One of the causes of their death is freezing of eggs in early layings. We have observed this twice. On May 13 in one nest there was one egg, on May 14 there appeared another egg, at night from 14 to 15 May they both froze at the temperature $-10^{\circ}$C. Another cause of mortality is magpies and crows which often destroy the nests. It is also quite probable that nestlings may be sometimes eaten by stoats when the nest is built in low situations. According to our observations, two out of 20 clutches (10%) perished because of cold, seven (35%) from predators, three (15%) from desertion by the parents at different stages of the nesting cycle. Only from eight (40%) nests the nestlings grew up to fly safely.

The breeding season of the Whitewinged Grosbeak is very prolonged. This may be seen from Table 2. Thus eggs in various stages of incubation may be found from the beginning of May to the end of July, i.e. almost during three whole months. The text-figure illustrates the dates of laying the first egg. The curve shows that the species has two peaks of reproduction : in May and in June. However, we believe that the statement in the literature about the existence of two clutches a year in this species (Dementjev & Gladkov 1954, Portenko 1960) is incorrect. We have every proof of this assumption tested by our observations of this bird both during the nesting and the post-nesting periods. As already mentioned the complete breeding cycle from the commencement of nest-building until the juveniles become independent takes more than one and a half months, i.e. from the point of view of nesting periods, double-peaked curve cannot result from double-nesting of the Whitewinged Grosbeak.

In our opinion, the prolongation of the laying period is due to the different environments existing on the mountain versants of different exposures. The southern mountain slopes are entirely devoid of snow already by the middle of May; they are then covered with verdure, the insects are active, and many passerine birds commence their nesting, including the Whitewinged Grosbeak. At the same time the northern versants are still thickly covered with snow, and the water here is still frozen. Visual examination of different species of birds, including the Whitewinged Grosbeaks, proved that when on the versants of southern

Dolgushin : Whitewinged Grosbeak

*Above :* The male Whitewinged Grosbeak passing the female juniper seeds ;
*Below :* The male and the female Whitewinged Grosbeaks feeding the chicks simultaneously.

(*Photos : E. Gavrilov*)

Dolgushin : Whitewinged Grosbeak

*Above :* The female Whitewinged Grosbeak swallowing the faecal sac. ; *Below :* Semi-fledged chicks of the Whitewinged Grosbeak in the nest.

(*Photos : E. Gavrilov*)

exposure birds have already commenced nesting, in less favourable localities many pairs are still migrating, looking for food; and judging

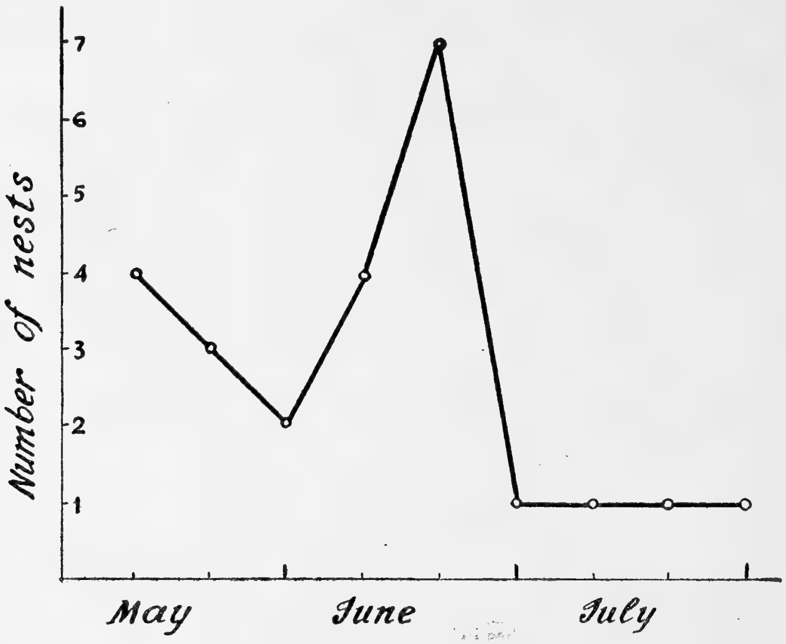
TABLE 2

LIST OF 28 NESTS OF THE WHITEWINGED GROSBEAK FROM THE ZAILIYSKY ALATAU

| Nest No. | Date | Nest contents | Nest No. | Date | Nest contents |
|---|---|---|---|---|---|
| 1. | May 12, 1965 | One new-laid egg. | 15. | June 10, 1964 | Building of the nest just commenced. |
| 2. | May 13, 1964 | One new-laid egg. | 16. | June 13, 1964 | One new-laid egg. |
| 3. | May 21, 1964 | Three new-laid eggs. | 17. | June 15, 1964 | Three eggs. Beginning of incubation. |
| 4. | May 27, 1964 | Three blind chicks 1-2 days old. | 18. | June 20, 1964 | Building of the nest just commenced. |
| 5. | May 27, 1964 | Four just hatched chicks. | 19. | June 22, 1964 | Two chicks with brushes in all pterylae. |
| 6. | May 31, 1964 | Three chicks semi-fledged; remiges 2 cm. long. | 20. | June 20, 1965 | Three eggs. Incubation. |
| 7. | June 2, 1965 | One new-laid egg. | 21. | June 23, 1965 | Three eggs. Incubation. |
| 8. | June 2, 1965 | Almost completed nest, still empty. | 22. | June 25, 1964 | Three fledglings. |
| 9. | June 4, 1965 | Three chicks with brushes in all pterylae. | 23. | June 26, 1964 | Three downy chicks. |
| 10. | June 5, 1964 | Four new-laid eggs. | 24. | July 4, 1964 | Four few-days old chicks. |
| 11. | June 5, 1964 | Four new-laid eggs. | 25. | July 11, 1965 | Three few-days old chicks. |
| 12. | June 6, 1965 | One new-laid egg. | 26. | July 28, 1964 | Three eggs and one chick. |
| 13. | June 7, 1964 | Chicks of unidentified age. | 27. | July 28, 1964 | Four eggs. Incubation. |
| 14. | June 8, 1965 | Almost completed nest still empty. | 28. | July 30, 1964 | Three hard set eggs, ready for hatching. |

from their behaviour it is clear that the time for their nesting is still far off. However, gradually all mountain slopes get free of snow, first the western, then the eastern and last of all the northern versants. Thus while on the southern versants the nestlings are leaving their nests, on the northern slopes the birds are only just commencing reproduction; they are building nests and laying eggs. To support these statements we can give the following data: on the versants of southern exposure in five nests the dates of laying the first egg varied from 3 to 13 May (average 6 May). On the versants of eastern exposure in 12 nests the first eggs were laid from 12 May to 24 July (average 9 June). On the versants of northern exposure in three nests the first eggs were laid from 11 to 17

June (average 13 June), and on the versants of western exposure in four nests the first eggs were laid from 2 June to 12 July, (average 16 June).




Thus, on the versants of southern exposure the Whitewinged Grosbeaks commence nesting 1-1·5 months earlier than on versants with any other exposure. This is illustrated by double-peak curve on the text-figure.

It must be mentioned that the problem of the length of the nesting period in the Whitewinged Grosbeak is complicated by the re-nesting of birds in the event of their first clutch being destroyed. However, the data at hand are too scanty to solve this problem. Probably the nesting period of the species is also influenced by the age of the birds, the old and the young ones commencing their reproduction at different times, as well as by differences in the time of maturing yearlings of the early and late broods. It is quite possible that there may exist some special micropopulations adapted to the conditions existing on the versants of different exposures. Very probably this surmise is true for the Whitewinged Grosbeak.

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# Coccids (Coccoidea: Hemiptera: Insecta) affecting Fruit Plants in Bihar (India)

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The Coccids of horticultural importance in Bihar have not received adequate attention. Misra (1923) published a list of these insects then known to occur in Bihar, but in the light of recent systematic studies his list needs revision. The present author made extensive collections of the Coccid fauna of Bihar in the period 1955-1959. An account of the Coccids affecting sugarcane in Bihar has already appeared (Ali 1962); the present communication is a taxonomic enumeration of thirty-four species of Coccoidea that affect fruit plants in Bihar.

This annotated list includes new distributional records of five species from this region. It also gives the distribution of the species in the Orient and particulars of their hosts, together with brief ecological or supplementary notes on some of those forms which the author has collected and observed during the course of his studies. In citing literature only those references have been mentioned which are necessary in tracing the nomenclatorial history of the species under report.

## I. Family MONOPHLEBIDAE

### Subfamily Monophlebinae

### Tribe Drosichini Morrison

#### 1. **Drosicha stebbingi** (Green)

1902 *Monophlebus stebbingii*[1] Green, Stebbing; *Dept. Notes Ins. Forestry* **1** : 133.
1903 *M. stebbingi* Green; *Indian Mus. Notes* **5** (3) : 101.
1928 *Drosicha stebbingi* (Green), Morrison; *U.S. Dept. Agr. Tech. Bull.* **52** : 169.
1949 *Drosicha stebbingi* (Green), Latif; *Bull. ent. Res. London* **40** (3) : 351.

Type locality : Dehra Dun, Uttar Pradesh, India.

Host : Sal tree (*Shorea robusta*).

[1] The spelling of the specific name was emended to *stebbingi* in the errata.

West Pakistan : on forty-four different host plants which include *Mangifera indica, Pyrus malus, P. communis*, etc., in Lyallpur, Lahore, Multan, and N.W.F. Province (Khan & Latif 1941, 1945). Indian Union : on Sal trees in Dehra Dun, Saharanpur, and Simla Divisions (Stebbing 1902) ; on *Mangifera indica, Tamarindus indica*, and *Ficus* spp. in Madhya Pradesh (Hingston 1929) ; on *Mangifera indica, Artocarpus integrifolia, Citrus* spp., *Anona squamosa, Litchi chinensis, Carica papaya, Musa* sp., etc. in the districts of Saran, Muzaffarpur, and Darbhanga (Haque 1955).[1]

## 2. **Drosicha dalbergiae** (Green)

1902 *Monophlebus dalbergiae* Green, Stebbing ; *Dept. Notes Ins. Forestry* **1** : 142.
1903 *Monophlebus dalbergiae* Green, *Indian Mus. Notes* **5** (3) : 101.
1928 *Drosicha dalbergiae* (Green), Morrison ; *U.S. Dept. Agr. Tech. Bull.* **52** : 169.

Type locality : Sutlej Valley at elevations between 710 to 1067 metres in the Punjab, India.

Host : *Dalbergia sissoo*.

I observed it in an epidemic form during 1955-1957 at Pusa. It was also found during 1955-1959 in and around Pusa, Muzaffarpur, Motihari, Bettia, Narkitiagunj, Hajipur, and Sonepur in Bihar on *Mangifera indica, Litchi chinensis, Psidium guajava, Punica granatum, Citrus* spp., *Achras sapota, A. integrifolia, Eugenia jambolana*, and other plants. It is usually found from the third week of December to the last week of May in Bihar. In case of severe infestation it may invade any vegetation in its surroundings and the males are of common occurrence in the field. The exuviae of early instars may be found even on railings and brick walls.

During the course of his studies on the new host of *D. stebbingi* (Green) in Bihar, Haque (1955) confused *D. dalbergiae* (Green) with the species *D. stebbingi* (Green). Examination of Haque's collections show that the specific determination by Haque (1955) was doubtful. Some of the specimens from his collections were also forwarded to the British Museum for identification and Dr. D. J. Williams, of the Commonwealth Institute of Entomology, London, remarks : ' this is the penultimate stage of a species close to *Drosicha dalbergiae* (Green). This stage has 7-segmented antennae, the adult female will have either 8- or 9-segmented antennae.' As such the list of host plants reported by Haque (1955) for *D. stebbingi* (Green) is doubtful.

Indian Union : on *Dalbergia sissoo* in the Sutlej Valley (Stebbing 1902) ; on *Citrus* sp. in Uttar Pradesh (Pruthi & Mani 1945), and on a number of other host plants in Bihar as mentioned above.

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[1] See author's remark under *D. dalbergiae* (Green) below.

### 3. **Drosicha mangiferae** (Green)

1903 *Monophlebus stebbingi* var. *mangiferae* Green, Stebbing ; *Dept. Notes Ins. Forestry* **2** : 332.

1908 *M. stebbingi* var. *octocaudata* Green ; *Mem. Dept. Agri. India* **2** (2) : 16.

1928 *Drosicha mangiferae* (Green), Morrison ; *U.S. Dept. Agr. Tech. Bull.* **52** : 169.

Type locality : Shalimar Gardens, Lahore, West Pakistan.

Host : *Mangifera indica.*

Originally the description of this species was made from males only as the adult females were unknown till then. A collection of Stebbing from *Shorea robusta* in Dehra Dun was described by Green (1903, and in Stebbing 1902) as *Monophlebus stebbingi* in which the presence of three pairs of caudal tassels in the male of this species was the specific character. Another collection from *Dalbergia sissoo* in the Sutlej Valley was designated as *Monophlebus dalbergiae* by the same author (Green 1908, and in Stebbing 1903) on account of four pairs of caudal tassels found in the male of this form. Subsequently, material from a mango orchard of the Shalimar Gardens, Lahore, was described by Green (in Stebbing 1903) as *Monophlebus stebbingi* var. *mangiferae* in which the young females were identical with *M. stebbingi* Green, but the males carried a very small fourth pair of caudal tassels. Later, Green (1908) proposed the name *M. stebbingi* var. *octocaudata* for the same material with a remark : ' differs from male of *dalbergiae* (which also has 8 appendages) in its much smaller size'. Again, Green (1923) published a synopsis of characters for the females of the species *M. phyllanthi*, *M. tamarindus*, *M. stebbingi*, *M. octocaudata*, and *M. dalbergiae* with the comment : ' I have not been able to find satisfactory characters to differentiate the females of *octocaudatus* and *dalbergiae* ; but the males of these two species may be distinguished by their size and by the character of the abdominal tassels'. Morrison (1928) replaced the genus *Monophlebus* by *Drosicha* and suggested the distinctiveness of the species *Drosicha stebbingi* (Green), *D. mangiferae* (Green) [placing *D. octocaudatus* (Green) as a synonym of *D. mangiferae* (Green)], and *D. dalbergiae* (Green) from the Indian region. The characters given by Morrison (1928) are quite helpful in distinguishing the two similar species *D. stebbingi* and *D. dalbergiae*, whereas they are not applicable for the separation of two species, namely, *D. dalbergiae* from *D. mangiferae*.

The finding of Latif (1949) that a great deal of variation takes place, either in the presence or in the development of the fourth pair of caudal tassels, within the males of the same species, and the fact that the two species (*D. stebbingi*, *D. mangiferae*) interbreed freely in nature (Rahman & Latif 1943) are liable to upset the specific status of all the three species *D. stebbingi*, *D. mangiferae*, and *D. dalbergiae*. As such a careful study

of the collections from different localities as well as a check-up of the type specimens are necessary before accepting the conclusions of Khan & Latif (1943) and Latif (1949) that *D. mangiferae* is a synonym of *D. stebbingi.*

*D. mangiferae* (Green) has been considered here, provisionally, as a distinct species, as the author has not seen the type specimen and he does not agree with the conclusions of Rahman & Latif (1943) and Latif (1949), but is of the opinion, on the basis of his field studies, that the species *D. mangiferae* actually refers to *D. dalbergiae*, to which it comes close, rather than *D. stebbingi* as pointed out by Latif (1949). The record of this species from Bihar by earlier workers appears to be of *D. dalbergiae* ; the author was not able to collect this species during the course of his studies in Bihar.

West Pakistan : since Khan & Latif (1941, 1945) considered it as a synonym of *D. stebbingi*, all those hosts which have been mentioned under *D. stebbingi* are common for this species. Indian Union : *Mangifera indica* at Sitamarhi and Dalsingsarai in Bihar (Stebbing 1903) ; practically on all trees including mango at Pusa, Bihar (Lefroy 1908), and on mango, jak, guava, papaya, citrus, jamun, *Ficus* sp., etc. in the districts of Bhagalpur, Santhal Parganas, Darbhanga, and Muzaffarpur (Sen *et al.* 1956).

Tribe : Iceryini Cockerell

4. **Icerya aegyptiaca** (Douglas)

1890 *Crossotosoma aegyptiacum* Douglas, *Ent. Mon. Mag.* **26** : 79.
1893 *Icerya aegyptiaca* (Douglas), Newstead ; *Ent. Mon. Mag.* **29** : 167.
1896 *I. tangalla* Green, *Indian Mus. Notes* **4** (1) : 7.
1950 *I. aegyptiaca* (Douglas), Rao ; *Indian J. Ent.* **12** (1) : 51 (1951).

Type locality : Alexandria, Egypt.

Host : Fruit trees.

The original home of this coccid is not known, but in 1885 it appeared as a serious pest on fruit trees in Alexandria, from where it was described. Since then it is commonly known as Egyptian mealy bug. In India it was observed by Miss Tomlin during 1892 in Madras, and later Cotes (1896) reported its occurrence from Calcutta. It is quite common in India, and Rao (1950) recorded forty-six different species of plants as its host in India, with a comment that it does great damage to fruit trees like custard apple, jak, sapota, citrus, and guava. He (Rao 1950) further reported its occurrence in Bihar from Rampur (Khas Mahal plantation) only, though Fletcher (1919) mentioned its record from Pusa and Ranchi

as well. I observed it in abundance on mango and guava, causing significant damage at Motihari, Manjhawlia, and Bettiah. It is also fairly common in the districts of Darbhanga, Muzaffarpur, Patna, Gaya, and Ranchi in Bihar on croton, citrus, jak, rose, and *Ficus,* in addition to mango and guava. It is a sporadic pest in Bihar, and usually found from February to August. The males are fairly common during March and April in north Bihar.

CEYLON : on several plants including rose, *Jatropha podagrica,* etc. FORMOSA : on citrus, tea, and many other plants, (Rao 1950). PHILIPPINE ISLANDS : on *Citrus, Morus alba,* and *Barleria cristata* (Morrison 1920, Rao 1950). INDIAN UNION : on forty-six different varieties of plants, in Bengal, Bihar, Bombay, Coorg, Cochin, Madras, Mysore, Orissa, and Travancore (Ayyar 1921, Pruthi & Mani 1945, Rao 1950). Further, the author has recently observed it on *Gracinia* sp. at Calcutta, West Bengal, during November 1964. THAILAND : on *Ceiba pentandra* and mango (Takahashi 1942).

### 5. **Icerya pulcher** (Leonardi)

1907 *Palaeococuss pulcher* Leonardi, *Ann. R. Scuola Agr. Portici* 7 (Ser. 2) : 3.
1928 *Icerya pulcher* (Leon.), Morrison ; *U.S. Dept. Agr. Tech. Bull.* **52** : 310.
1932 *Icerya pulcher* (Leon.), Green ; *Stylops London* **1** (2) : 32.
1952 *Icerya pulcher* (Leon.), Rao ; *Indian J. Ent.* **12** (2) : 68.

Type locality : Java.

Host : *Ilex* sp.

Recently it has been recorded from India by the present author (Ali 1962). It was observed only at Pusa, Bihar, on mango leaves from February to July.

SINGAPORE : on *Rhopaloblasta* palm, *Michelia champaca.* JAVA : on citrus, *Mangifera* sp., and rose. PHILIPPINE ISLANDS : on *Guinta* beans. SUMATRA : on orange and coconut (Rao 1950). INDIAN UNION : on *Mangifera indica* at Pusa, Bihar (Ali 1962).

### 6. **Icerya minor** Green

1908 *Icerya minor* Green, *Mem. Dept. Agri. India* **2** (2) : 17 (Ent. Ser.).
1928 *Icerya minor* Green, Morrison ; *U.S. Dept. Agr. Tech. Bull.* **52** : 210.
1950 *Icerya minor* Green, Rao ; *Indian J. Ent.* **12** (1) : 62.

Type locality : Pusa, Bihar, India.

Host : Mango.

INDIAN UNION : on mango at Pusa, Bihar (Green 1908) ; on Citrus and guava in Assam and only on guava at Benares in Uttar Pradesh (Rao 1950).

Tribe : Monophlebini Cockerell

7. **Aspidoproctus cinerea** (Green)

1908 *Walkeriana cinerea* Green, *Mem. Dept. Agri. India* **2** (2) : 17 (*Nom. nud.*).
1922 *Aspidoproctus cinerea* (Green), *Cocc. Ceylon* **5** : 450.
1930 *Aspidoproctus cinerea* (Green), Ayyar ; *Bull. Dept. Agri. India* **197** : 69.

Type locality : Ceylon.

Host : On *Grevillea* sp.

Originally it was collected from *Acacia arabica* in Surat and named by Green (1908) as *W. cinerea* but no description was published till 1922 when he described it from Ceylon as *A. cinerea.*

CEYLON : on *Grevillea* sp., *Citrus* sp., *Terminalia* sp., *Thespesia* sp., etc. (Green, 1922). INDIAN UNION : on *Lawsonia alba* and *Acacia arabica* in Surat (Lefroy 1908, Misra 1923) : on pomegranate, *Lawsonia alba,* and sandalwood, etc., in south India (Ayyar 1921) ; on *Achras sapota* at Pusa, Bihar (Misra 1923).

II. Family PSEUDOCOCCIDAE

Subfamily Pseudococcinae

8. **Ferrisiana virgata** (Cockerell)

1893 *Dactylopius virgatus* Cockerell, *The Entom.* **26** : 178.
1893 *D. virgatus* var. *farinosus* Cockerell, ibid. **26** : 178.
1893 *D. virgatus* var. *humilis* Cockerell, ibid. **26** : 179.
1896 *D. dasylirii* Cockerell, *Jn. N.Y. Ent. Soc.* **4** : 202.
1896 *D. ceriferus* Newstead, *Indian Mus. Notes* **3** (5) : 24.
1897 *D. talini* Green, ibid. **4** (1) : 7.
1912 *Pseudococcus marchali* Vayssiere, *Soc. Ent. de France Bull.* **17** : 366-368.
1915 *P. bicaudatus* Keuchenius, *Med. Bez. Proefst. Djemba* **16** : 1-65.
1920 *Pseudococcus virgatus* (Ckll), Morrison, *Philip. Jour. Sci.* **17** (2).
1950 *Ferrisiana virgata* (Cockerell) Ferris ; *Atlas Scale Ins. N. America* **5**.
1962 *Ferrisiana virgata* (Cockerell), Ali ; *Indian J. Ent.* **23** (3) : 236 (1961).

Type locality : Kingston, Jamaica.

Host : On a tree.

The list of host plants of this species in the oriental region is endless and it may be expected to occur on almost any flowering plant. In India

it has been reported from Assam, Bengal, Bihar, Bombay, Hyderabad, Madhya Pradesh, Madras, and Mysore on forty different varieties of plants by Ali (1962). It is one of the common mealy bugs, widely distributed in the districts of Darbhanga, Muzaffarpur, Champaran, and Saran in Bihar. It may be found in different stages of its development, throughout the year clustering upon the terminal shoots, leaves, and fruits of the host plants, like custard apple, crotons, guava, jak, plantain, *Phyllanthus emblica*, aerial roots of banyan, *Ipomoea hederacea*, *Mimusops elengi*, etc. It does considerable damage, especially to custard apple and crotons, from April to September, and often its infestation proves fatal to young plants in Bihar.

CEYLON : on a number of plants (Ayyar 1919, 1921, 1930). FORMOSA : on *Bauhinia* sp. JAVA : probably on citrus (Pruthi & Mani 1945). MALAY PENINSULA : on guava (Takahashi 1950). PHILIPPINE ISLANDS : on a number of plants, including *Anona squamosa* and *Psidium* sp. etc. (Cockerell 1907, Cockerell & Robinson 1915, Robinson 1917, Morrison 1920). INDIAN UNION : on forty different host plants (Ali 1962). INDO-CHINA : on *Albizzia* sp. THAILAND : on legume and other plants (Takahashi 1942).

### 9. **Nippaecoccus vastator** (Maskell)

1895 *Dactylopius vastator* Maskell, *New Zel. Inst. Trans. & Proc.* **27** (1894).

1910 *D. perniciosus* Newstead & Willcock, *Bull. ent. Res. London* **1** : 133.

1948 *Nipaecoccus vastator* (Maskell), Zimmerman ; *Honolulu Univ. Press* **464** : 132.

1950 *Nipaecoccus vastator* (Maskell), Ferris ; *Atlas Scale Ins. N. America* : **5**.

1957 *Pseudococcus vastator* ((Maskell), Ali, *Indian J. Ent.* **19** (1) : 54.

1962 *Nipaecoccus vastator* (Maskell) Ali, ibid. **23** (4) : 304 (1961).

Type locality : Sandwich Island.

Host : Citrus.

A new distributional record of this species has been established from India by Ali (1957). It is quite common in Bihar from April to November on *Citrus* spp., *Phyllanthus emblica*, *Artocarpus integrifolia*, *Abelmoschus esculentus*, *Gossypium* sp., and *Dalbergia sissoo*, in the districts of Darbhanga, Muzaffarpur, Champaran, Patna, and Gaya. An Aphelinid parasite, *Eriaporus aphelincides* Cam., is an effective enemy of this pest at Pusa, Bihar.

INDIAN UNION : on *Citrus* spp., *Euphorbia* sp., and *Dalbergia sissoo* in Uttar Pradesh (Ali 1957), on tea in Assam (Das 1959), as above in Bihar (Ali 1962) and the author recently observed it on *Citrus* sp. and *Zizyphus* sp. at Calcutta in West Bengal.

### 10. **Phenacoccus ballardi** Newstead

1917 *Phenacoccus ballardi* Newstead, *Bull. ent. Res. London* **8** : 17.
1921 *Phenacoccus ballardi* Newstead, Ayyar ; *Proc, 4th. Ent. Mtg. Pusa* : 334.

Type locality : Coimbatore, south India.

Host : Mango.

INDIAN UNION : on mango at Pusa, Bihar, and in south India (Ayyar 1921).

### 11. **Phenacoccus hirsutus** Green

1908 *Phenacoccus hirsutus* Green, *Mem. Dept. Agri. India* **2** (2) : 25 (Ent. Ser.).
1921 *Phenacoccus hirsutus* Green, Ayyar ; *Proc. 4th. Ent. Mtg. Pusa* : **3.**
1958 *Phenacoccus hirsutus* Green, Williams; *Bull. B.M. Nat. Hist.* **6** (8) : 228.

Type locality : not known (probably northern India).

Host : Undetermined.

PHILIPPINE ISLANDS : on *Hibiscus* sp., *Samanea saman* (Morrison 1920). INDIAN UNION : on *Ficus* sp. at Mohol in Sholapur (Kasargode 1914) ; on *Morus* sp. at Pusa, Bihar, and in Bengal (Fletcher 1919). THAILAND : on *Hibiscus* sp. (Takahashi 1942).

### 12. **Rastrococcus iceryoides** (Green)

1908 *Phenacoccus iceryoides* Green, *Mem. Dept. Agri. India* **2** (2) : 26 (Ent. S.).
1921 *Phenacoccus iceryoides* Green, Ayyar, *Proc. 4th. Ent. Mtg. Pusa*: 3.
1922 *Dactylopius obtusus* Newstead, Green ; *Cocc. Ceylon* **5** : 391.
1954 *Rastrococcus iceryoides* (Green), Ferris ; *Microentomology* **19** : 51.

Type locality : Calcutta, India.

Host : Mango.

It was observed at Pusa on sapota leaves and fruit in November 1956—a new distributional record for this species from Bihar.

MALAY PENINSULA : most common on *Cassia*, cacao, *Cajanus*, *Centrosema*, *Citrus* sp., coffee, *Crotalaria*, cotton, *Derris*, *Gardenia*, *Ficus* sp., *Michelia*, *Mangifera*, *Vitex*, *Phyllanthus*, and twelve other host plants (Takahashi 1950). INDIAN UNION : on a number of wild and cultivated plants in different parts of north and south India (Ayyar 1921), sporadic major pest of *Citrus* spp. in several parts of India Pruthi & Mani 1945) ; on sapota at Pusa, Bihar, as mentioned above.

### 13. **Centrococcus insolitus** (Green)

1908 *Phenacoccus insolitus* Green, *Mem. Dept. Agri. India* **2** (2) : 26 (Ent. S.).

Type locality : Pusa, Bihar, India.

Host : *Sida cordifolia.*

INDIAN UNION : throughout India on brinjal (*Solanum melongena*) (Fletcher 1919, Ayyar 1921) ; on Cape gooseberry (*Physalis maxima*) at Pusa, Bihar (Fletcher 1921).

## III. Family COCCIDAE

### Subfamily Coccinae

### Tribe Pulvinariini

### 14. **Pulvinaria polygonata** Cockerell

1905 *Pulvinaria polygonata* Cockerell, *Proc. Dav. Acad. Sci. Iowa.* **10** : 131.
1917 *Pulvinaria polygonata* Cockerell, Robinson, *Philippine Jour. Sci.* **12** (1) : 10.
1920 *Pulvinaria polygonata* Cockerell, Morrison ; ibid. **17** (2) : 182.

Type locality : Manila.

Host : cultivated shade-tree.

PHILIPPINE ISLANDS : on orange, *Citrus nobilis*, and shade-trees (Cockerell 1907, Robinson 1917, and Morrison 1920). INDIAN UNION : on mango leaves and shoots at Pusa, Bihar (Misra 1923).

### 15. **Pulvinaria cellulosa** Green

1909 *Pulvinaria cellulosa* Green, *Cocc. Ceylon* **4** : 262.
1964 *Pulvinaria cellulosa* Green, Ali, *Indian J. Ent.* **26** (3) : 361.

Type locality : Pundaluoya, Ceylon.

Host : Citrus.

Morrison (1920) considered it to be a synonym of *Pulvinaria polygonata* Cockerell. But it has been regarded here, provisionally, as a distinct species on the basis of the identification report of the British Museum, London.

CEYLON : on *Citrus* sp. (Green 1909). INDIAN UNION : only in Bihar on mango (Misra 1923), serious sporadic pest in Bihar on citrus and mango (Ali 1964).

### 16. **Pulvinaria psidii** Maskell

1892 *Pulvinaria psidii* Maskell, *New Zel. Inst. Trans. & Proc.* **25** : 223.
1917 *Pulvinaria psidii philippina* Robinson, *Philippine Jour. Sci.* **12** (1).
1920 *Pulvinaria psidii* Maskell, Morrison ; ibid. **17** (2) : 182.

Type locality : Sandwich Island.

Host : Guava (*Psidium*).

In India, it is one of the commonest and most destructive in south India on a variety of plants like guava, mango, coffee, tea, etc. In Bihar, Fletcher (1919) and Misra (1923) reported its occurrence on mango and litchi only, but I observed it on guava also at Muzaffarpur during April to September months. It is similar in appearance to *P. cellulosa* Green, especially after the formation of the ovisac. So far as the author is aware, it has never assumed a serious pest status in Bihar.

Ceylon : on guava, tea (Green 1896). Formosa and Sumatra : on *Citrus* sp. and other plants (Pruthi & Mani 1945). Indian Union : all over India on guava, mango, jamun, loquat (*Eriobotrya japonica*), tea, coffee, etc. (Lefroy 1908, Fletcher 1919, Ayyar 1921, Misra 1923). Philippine Islands : on *Citrus* sp., *Eugenia jambolana*, *Psidium guajava*, *Ficus* sp. (Robinson 1917, Morrison 1920, Pruthi & Mani 1945). Thailand : on *Euphoria longana* and *Ficus* sp. (Takahashi 1942).

## Tribe Coccini

### 17. **Coccus discrepans** (Green)

1904 *Lecanium discrepans* Green, *Cocc. Ceylon* **3** : 204.
1961 *Coccus discrepans* (Green), Das & Ganguli ; *Indian J. Ent.* **23** (4) : 247.

Type locality : Pundaluoya, Ceylon.

Host : On Tea plants.

Ceylon : on tea (Green 1904). Indian Union : on mango and banana (*Musa* sp.) in south India (Fletcher 1919, Ayyar 1921); on plantain at Gauhati (Fletcher 1921) ; on tea at Tocklai (Das & Ganguli 1961) ; on *Zizyphus jujuba* at Pusa, Bihar (Misra 1923).

### 18. **Coccus mangiferae** (Green)

1899 *Lecanium mangiferae* Green, *Ent. Mon. Mag.* **35** : 249.
1903 *Coccus mangiferae* (Green), Fernald ; *Cat. Cocci. World* : 172.
1904 *Lecanium mangiferae* Green, *Cocc. Ceylon* **3** : 216.
1920 *Coccus mangiferae* (Green), Morrison, *Philippine Jour. Sci.* **17** (2) : 200.

Type locality : Ceylon.

Host : Mango.

CEYLON : on mango (Green 1904). PHILIPPINE ISLANDS : on *Cocos nucifera* (Morrison 1920). INDIAN UNION : on mango at Pusa, Bihar (Fletcher 1919). THAILAND : on *Ficus* sp. (Takahashi 1942).

### Subfamily Ceroplastinae

### 19. **Ceroplastes ceriferus** (Anderson)

1791 *Coccus ceriferi* Anderson, *Monogr. Cocci Ceriferi Madras.*
1872 *Ceroplastes ceriferus* (Anderson), Signoret ; *Ann. Soc. Ent. Fr.* **2** (5) : 40.
1903 *Ceroplastes ceriferus* (Anderson), Fernald ; *Cat. Cocci. World* : 149.
1920 *Ceroplastes ceriferus* (Anderson), Morrison ; *Philip. Jour. Sci.* **17** (2) 200.

Type locality : Madras, India.

Host : *Celastrus ceriferus.*

CEYLON : on *Antigonon, Poutzolzia,* mulberry, tea, *Ficus* spp., etc. (Green 1896, Ayyar 1921). FORMOSA (Pruthi & Mani 1945) ; PHILIPPINE ISLANDS : on *Phytocrene* and *Ficus hauili* (Morrison 1920) ; INDIAN UNION : on tea in Kangra Valley (Atkinson 1889) ; on tea in Assam and Darjeeling (Das & Ganguli 1961) ; on *Lawsonia alba, Boswellia, Asclepiadron,* etc. in south India ; on *Terminalia, Buchanania,* etc. in Madhya Pradesh (Ayyar 1919, 1921) ; on *Casuarina* in Bombay (Misra 1923) ; on mango, pipal, and arjoon trees in Ranchi, Chota Nagpur, Bihar (Cotes 1891). THAILAND : on *Euphoria longana* (Takahashi 1942).

### 20. **Ceroplastes pseudoceriferus** Green

1933 *Ceroplastes pseudoceriferus* Green, *Stylop London* **4** (8) : 180.
1959 *Ceroplastes pseudoceriferus* Green, Sankaran ; *J. Bombay nat. Hist. Soc.* **56** (1) : 39.

Type locality : Ceylon.

Host : Undetermined.

This is a new distributional record for this species in Bihar. It was observed heavily clustered upon mango shoots causing considerable damage specially to the seedlings at Motihari during February 1956. Again, in 1957 and 1958, it appeared as a menace to ' Maha Buddha Tree ' (*Ficus religiosa*) along with one more unidentified mealy bug at Buddha Gaya in south Bihar. Later it was effectively controlled by the State Department of Agriculture, Bihar.

CEYLON : on undetermined plant (Green 1933). INDIAN UNION : on *Azadirachta indica* and *Diospyros montana* (Green 1935) ; on *Madhuca longifolia* in south India, on *Mangifera indica, Ficus religiosa, F. glomerata, F. bengalensis, Artocarpus heterophylla, Madhuca indica, Mimusops hexandra, Terminalia chebula,* and *Holoptelea integrifolia* in Benares, Uttar Pradesh (Sankaran 1959) ; and on *Mangifera indica* and *Ficus religiosa* at Motihari and Gaya in Bihar as mentioned above.

### 21. **Ceroplastes floridensis** Comstock

1880 *Ceroplastes floridensis* Comstock, *Rep. U.S. Dep. Agr.* : **331** (1881).
1880 *Ceroplastes rusci* Ashmead, *Can. Ent.* **12** : 252.
1903 *Ceroplastes floridensis* Comstock, Fernald ; *Cat. Cocci. World* : 152.
1909 *Ceroplastes floridensis* Comstock, (Green 1896) ; *Cocc. Ceylon* **4** : 277.

Type locality : Florida.

Host : ?

CEYLON : on guava, mango, citrus, tea, etc. (Green 1896, 1909). JAVA : on mango and citrus (Green 1900). FORMOSA (Pruthi & Mani 1945). INDIAN UNION : on *Michaelia, Anacardium occidentale,* etc. in south India (Ayyar 1919) ; on mango ; minor sporadic pest of citrus, guava, *Ficus carica* in different parts of India (Fletcher 1919, Pruthi & Mani 1945) ; on tea in Assam and Darjeeling (Das & Ganguli 1961) ; and on *Anona squamosa* at Pusa, Bihar (Misra 1923).

### 22. **Ceroplastes actiniformis** Green

1896 *Ceroplastes actiniformis* Green, *Indian Mus. Notes* **4** (1) : 9.
1909 *Ceroplastes actiniformis* Green, *Cocc. Ceylon* **4** : 275.

Type locality : Pundaluoya, Ceylon.

Host : Coconut palm.

It is quite common in north Bihar on mango and guava from April to September. Usually found singly distributed on shoots and leaves in different stages of its development. Once seen on sugarcane leaves (Ali 1962), but this appears to be an accidental host for the species.

CEYLON : on Coconut palm and some other plants (Green 1896). INDIAN UNION : on coconut, mango, etc., in south India (Ayyar 1919) ; on loranthus in Poona (Fletcher 1919), on *Ficus carica* at Pusa, Bihar (Misra 1923) ; on mango and guava as mentioned above.

## IV. Family Diaspididae

### Subfamily Diaspidinae

### Tribe Aspidiotini

### 23. **Aonidiella aurantii** (Maskell)

1878 *Aspidiotus aurantii* Maskell, *New Zel. Inst. Trans. & Proc.* **11** : 199.

1881 *A. citri* Comstock, *Rep. U.S. Dept. Agri.* 293 (1880).

1881 *A. coccineus* Gennadius, *Ann. Soc. Ent. Fr.* **1** (6) : 189.

1887 *Aspidiotus gennadii* (Targioni), Penzig ; *Studi Bot. Sug. Agr.* : 497.

1903 *Chrysomphalus aurantii* (Maskell), Fernald ; *Cat. Cocc. World* : 287.

1938 *Aonidiella aurantii* (Maskell), Ferris ; *Atlas Scale Inst. America* SII-179.

Type locality : Sydney.

Host : Orange.

Burma : on *Citrus* sp. (Misra 1923). Ceylon : On *Agave*, and *Citrus* spp. (Green 1896). Formosa : on Citrus (Ferris 1921). Philippine Islands : on *Artocarpus* sp. (Cockerell 1907) and on *Astronia* (Robinson 1917). West Pakistan : on Citrus (Pruthi & Mani 1945). Indian Union : practically common all over India and thrive best in a semi-arid climate. They are usually found on *Citrus* spp., mulberry, *cycas*, rose, etc. (Fletcher 1919, Ayyar 1921) ; on rose and orange leaves at Pusa, Bihar (Misra 1923). Indo-China and Thailand : on *Citrus* sp. (Takahashi 1942).

### 24. **Aonidiella orientalis** (Newstead)

1894 *Aspidiotus orientalis* Newstead, *Indian Mus. Notes* **3** (5) : 26.

1896 *A. osbeckiae* Green, ibid. **4** (1) : 4.

1896 *A. osbeckiae* Green, *Cocc. Ceylon* **1** : 47.

1897 *A. (Diaspidiotus) osbeckiae* (Green), Cockerell ; *Bull. Tech. Ser.* **6**, *U.S. Dept. Agri.* : 28.

1898 *A. (Evaspidiotus) osbeckiae* (Green), Leonardi ; *Riv. Pat. Veg.* **7** : 77.

1898 *A. (Evaspidiotus) orientalis* (Newstead), Leonardi ; ibid. **7** : 79.

1908 *A. (Aonidiella) cocotiphagus* Marlatt, *U.S. Dept. Agr. Ent. Tech. Ser.* **16** : 11.

1908 *A. orientalis* var. *cocotiphagus* Marlatt ; ibid. *Ser.* **16** : 11-32.

1915 *Chrysomphalus pedroniformis* Cockerell & Robinson, *Bull. American Mus. Nat. Hist.* **34** : 107.

1938 *Aonidiella orientalis* (Newstead), Ferris ; *Atlas Scale Inst. N. America* : SII-180.

Type locality : Seven Pagodas, Madras, India.

Host : unknown (probably, a species of *Panicum* grass).

BURMA : on *Ficus religiosa* (Misra 1923). CEYLON : on *Osbeckia* (Green 1896), and on *Atylosia* (Ayyar 1921). PHILIPPINE ISLANDS : on *Vitis vinifera* and *Eriodendron anfractuosum* (Cockerell & Robinson 1915, Robinson 1917). INDIAN UNION : on *Tamarindus indica* and *Solanum melongena* in south India, on coconut palm in Travancore, on rose in Bombay and Poona, on guava and plantain leaves in Madhya Pradesh (Ayyar 1921, Fletcher 1919) ; on *Eugenia jambolana, Zizyphus jujuba, Tamarindus indica,* plantain leaves, *Melia azadirachta,* etc. at Pusa, Muzaffarpur, and Darbhanga in Bihar (Fletcher 1919, Misra 1923).

### 25. **Aspidiotus destructor** Signoret

1869 *Aspidiotus destructor* Signoret, *Ann. Soc. Ent. Fr.* **9** (4) : 120.

1869 *A. lataniae* Signoret, ibid. **2** (4) : 124.

1890 *A. transparens* Green, *Insect Pest of Tea Plants* : 22.

1938 *A. destructor* Signoret, Ferris ; *Atlas Scale Ins. N. America,* SII-191.

Type locality : Reunion Island.

Host : Palms and *Psidium guajava.*

CEYLON : on mango, *Ficus carica,* tea, rubber, etc. (Green 1900). FORMOSA : on *Morus alba* (Ferris 1921). PHILIPPINE ISLANDS : on *Mangifera indica, Mangifera verticillata, Eugenia calubcob, Cocos nucifera,* etc. (Robinson 1917). INDIAN UNION : a minor sporadic pest throughout the plains and low hills of the country. Occurs on mango, apple, peach, orange, citrus, jamun, *Zizyphus jujuba, Tamarindus indica, Psidium guajava, Cocos nucifera, Phoenix* sp., etc. all over India and on *Cocos nucifera* in Laccadive Islands (Maskell 1896, Green 1908, Fletcher 1919, Ayyar 1921, Misra 1923). INDO-CHINA and THAILAND : on mango and palm (Takahashi 1942).

### 26. **Pseudaonidia trilobitiformis** (Green)

1896 *Aspidiotus trilobitiformis* Green, *Indian Mus. Notes* **4** (1) : 4.

1896 *Aspidiotus trilobitiformis* Green, *Cocc. Ceylon* **1** : 31.

1903 *Pseudaonidia trilobitiformis* (Green), Fernald ; *Cat. Cocc. World* : 284.

1921 *Pseudaonidia trilobitiformis* (Green), Ferris ; *Bull. ent. Res., London* **12** : 218.

Type locality : Pundaluoya, Ceylon.

Host: Unidentified tree.

CEYLON : on leaves of unidentified tree (Green 1896) and on *Dalbergia championii* (Fletcher 1919). FORMOSA : on *Citrus* sp. (Ferris 1921). PHILIPPINE ISLANDS : on *Artocarpus* sp. (Cockerell & Robinson

1915). Indian Union : on unidentified plant in Calcutta (Green 1903), on *Mimusops elengi, Ixora* sp., and mango leaves in south India (Fletcher 1919), and only on mango leaves at Pusa, Bihar (Misra 1923). Indo-China and Thailand : on *Ficus* sp. (Takahashi 1942).

### Tribe Diaspidini

### 27. **Chionaspis pusa** Rao

1923 *Chionaspis pusa* Green, Misra ; *Proc. 5th Ent. Mtg. Pusa* 348. (*Nom nud.*).
1953 *Chionaspis pusa* Sp. n., Rao, *Proc. R. ent. Soc. London* (B) **22** (3 & 4) : 62.

Type locality : Pusa, Bihar, India.

Host : *Citrus* sp.

Misra (1923) referred this species under manuscript name, but actually no description was published until Rao (1953) examined its type specimen and described it, provisionally, under *Chionaspis* as originally placed by Green with his (Rao 1953) comment that ' it would require a review of the whole group of species referred to the genus *Chionaspis* to determine exactly the generic position of this species '.

Indian Union : on *Citrus* sp. at Pusa, Bihar (Misra 1923, Rao 1953).

### 28. **Aulacaspis mangiferae** (Newstead)

1908 *Diaspis cinnamomi* Newstead, *Jour. Econ. Biol.* **3** : 34.
1919 *Diaspis cinnamomi mangiferae* (Newstead), Green; *Rec. Ind. Mus.*, **16** : 433.
1930 *Diaspis cinnamomi mangiferae* (Newst.), Ayyar ; *Dept. Agri. India, Bull.* **197** : 14.
1952 *Aulacaspis mangiferae* (Newst.), Scott, *Microentomology* **17** (2) : 35.

Type locality : East Java.

Host : *Cinnamomum ceylanicum.*

Indian Union : on mango at Bangalore and at Pusa, Bihar (Green 1919, Misra 1923). Java : as above.

### 29. **Lepidosaphes gloverri** (Packard)

1869 *Coccus gloverii* Packard, *Guide to study of Ins. Ed.* **1** : 527.
1872 *Aspidiotus gloverii* (Packard), ibid. *Ed.* **2** : 527.
1938 *Mytilaspis gloverii* (Packard), Ferris ; *Atlas Scale Ins. N. America* : SI-74.
1938 *Mytilella sexspina* Hoke, Ferris ; ibid. : SI-74.
1938 *Lepidosaphes gloverri* (Packard), Ferris ; ibid. : SI-74.

Type locality : Florida.

Host : *Citrus* sp.

CEYLON : on orange (Ayyar 1921). SOUTHERN CHINA and PHILIPPINE ISLANDS : on *Citrus* sp., (Pruthi & Mani 1945). INDIAN UNION : on mango and croton leaves at Pusa, Bihar (Misra 1923).

### 30. **Parlatoria camelliae** (Comstock)

1883 *Parlatoria pergandii* var. *camelliae* Comstock, *Agr. Expt. Stat. Rept. Cornell* **2** : 114.

1939 *Parlatoria camelliae* (Comstock), Morrison ; *Misc. Pub.* No. **344**, *U.S. Dept. Agr.* : 8.

1945 *Parlatoria camelliae* (Comstock), Mckenzie, *Microentomology* **10** (2) : 57.

Type locality : North America.

Host : Camellia.

JAVA : on mango (Morrison 1939). WEST PAKISTAN : on olive (Misra 1923). INDIAN UNION : on *Aegele* sp., *Azadirachta* sp., *Melia* sp., and *Vitis* sp., in different parts of the country (Ayyar 1921, Morrison 1939), on mango leaves in Rajputana, and only on *Aegele marmelos* at Pusa, Bihar (Misra 1923).

### 31. **Parlatoria oleae** (Colvee)

1880 *Diaspis oleae* Colvee, *Gac. Agr. Min. de Fomento (Spain)*. **14** (2) : 39.

1895 *Parlatoria calianthina* Berlese & Leonardi, *Riv. di. Patob. Veg.* **3** : 346.

1897 *Parlatoria affinis* Newstead *Tran. Ent. Soc. Lond.* : 97.

1935 *Parlatoria oleae* (Colvee), Nichol & Wehrle, *Ariz. Agr. Expt. Sta. Tech. Bull.* **56** : 201-235.

1937 *Parlatoria oleae* (Colvee), Ferris, *Atlas Scale Ins. N. America* SI-87.

1937 *Syngenaspis oleae* (Colvee), Borkhsenius, *U.S.S.R. Agr. Plant Quarantine, Georgia* : 87.

1939 *Parlatoria oleae* (Colvee) Morrison, *Misc. Pub. No.* **344**, *U.S. Dept. Agr.* : 15.

1946 *Parlatoria oleae* (Colvee), Mckenzie, *Microentomology* **10** (2) : 69.

Type locality[1] : Spain.

Host : Olive.

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[1] Spain *vide* Mckenzie 1946 and Italy *vide* Ferris 1937.

INDIAN UNION : on peach, pears, and plums in Bengal and at Ranchi, Hinoo, Jaganathpur, Kanke, Nankum in Bihar (Rao & Chatterjee 1948).

### 32. **Phenacaspis dilatata** (Green)

1899 *Chionaspis dilatata* Green, *Cocc. Ceylon* **2** : 148 & *Ann. Appl. Biol.* **5** (2) : 46 (1919).

1903 *Phenacaspis dilatata* (Green), Fernald ; *Cat. Cocci. World* : 273.

Type locality : Kandy, Ceylon.

Host : *Eurycles* sp.

CEYLON : on mango, *Eurycles* sp., *Myristica* spp., etc. (Green 1899). EAST PAKISTAN : on mango leaves in Dacca (Misra 1923). INDIAN UNION : on palm in Bangalore and Calcutta and on mango leaves at Pusa, Bihar (Misra 1923, Ayyar 1921, Fletcher 1919).

### 33. **Phenacaspis megaloba** (Green)

1899 *Chionaspis megaloba* Green, *Cocc. Ceylon* **2** : 149 & *Rec. Indian Mus.* **16** : 438.

1903 *Phenacaspis megaloba* (Green), Fernald ; *Cat. Cocci. World* : 238.

Type locality : Kandy, Ceylon.

Host : *Psidium* sp.

CEYLON : on *Psidium* sp. and *Actinoclaphne molochina* (Green 1899) ; INDIAN UNION : on *Zizyphus jujuba* at Pusa, Bihar (Misra 1923).

### 34. **Phenacaspis vitis** (Green)

1896 *Chionaspis vitis* Green, *Indian Mus. Notes* **4** (1) : 3.

1899 *Chionaspis vitis* Green, *Cocc. Ceylon* **2** : 140.

1903 *Chionaspis vitis* Green, Fernald ; *Cat. Cocc. World* : 286.

1942 *Phenacaspis vitis* (Green), Takahashi, *Rept. Govt. Agr. Res. Inst. Formosa* **81** : 33.

Type locality : Pundulaoya, Ceylon.

Host : on *Vitis* sp.

CEYLON : on *Vitis lanceolaria*, *Elaeagnus latifolia*, and *Loranthus* sp. (Green 1896, Fernald 1903, Fletcher 1919). INDIAN UNION : on *Elaeagnus* sp. and mango in south India ; only on mango at Pusa, Bihar (Fletcher 1919, Ayyar 1921). THAILAND : on undetermined tree (Takahashi 1942).

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# Sea Anemones (Actiniaria) of Bombay

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(*With two plates and a map*)

A collection of sea anemones from the intertidal region of different localities of the Bombay shore are described. For each species, the habit and preferred habitat, size range, coloration, distinguishing external features, association and distribution are given. Out of 17 species, two are new and seven new records for India. A key to the identification of sea anemones of Bombay is given.

## INTRODUCTION

Sea anemones form an important group of intertidal organisms. On Bombay shores, as elsewhere, they are distinguished by their habit, habitat and beautiful coloration. Information about the sea anemones of Bombay is rather meagre being limited to notes by Dave (1957) and Bhatt (1959). Dr. Cutress (Personal communication) of Puerto Rico University, collected 12 species from this area.

Seventeen species of intertidal sea anemones, collected from different localities, viz. Cuffe Parade, Secretariat Foreshore, Chaupatty, Breach Candy, Worli, Dadar, Mahim, Versova, Madh, Manori and Mazagaon Docks, within Bombay City limits (See Map) are described in this paper. The specimens have been identified up to species level except for two forms for which only generic identification is given. The notes on coloration are based on live specimens. For technical terms used in the description of species the actinian glossary of Carlgren (1949) is followed.

The intertidal actinian fauna of Bombay of 17 species, belong to 9 families and 15 genera. Of these, *Anemonia indicus* and *Acontiophorum bombayensis* are new species (Parulekar 1968). The undescribed *Cribrinopsis* sp. and *Aiptasia* sp. require more observations for determining their taxonomic position.

Amongst the sea anemones reported in this paper, *Bunodosoma granulifera*, *Anthopleura midori*, *Anthopleura asiatica*, *Anthopleura pacifica*, *Actiniogeton sultana*, *Metridium senile* var. *fimbriatum* and *Aiptasiomorpha luciae* are new records for India.

A survey of the geographical distribution reveals that sea anemones of Bombay are chiefly composed of Indo-Pacific forms. Of the

17 species recorded here, eight described by various authors (Panikkar 1939, Dave 1957, and Parulekar 1968) are confined to Indian waters. Three species of the genus *Anthopleura*, were known previously only from Japan (Uchida 1958) and *M. senile* var *fimbriatum*, *A. sultana*, *B. granulifera* and *A. luciae* have been reported from Pacific, Atlantic and Indian Oceans.

## LIST OF SPECIES

Order ACTINIARIA

Tribe Nynatheae

Sub-tribe *Athenaria*

Family EDWARDSIIDAE Andres, 1880

Genus *EDWARDSIA* Quatrefages, 1862

1. **Edwardsia tinctrix** Annandale, 1915

Family HALOCLAVIDAE Verrill, 1899

Genus *METAPEACHIA* Carlgren, 1943

2. **Metapeachia tropica** (Panikkar), 1939

Family HALIACTIIDAE Carlgren, 1949

Genus *PELOCOETES* Annandale, 1915

3. **Pelocoetes exul** Annandale, 1915

Genus *PHYTOCOETES* Annandale, 1915

4. **Phytocoetes gangeticus** Annandale, 1915

Tribe Thenarra Carlgren, 1899

Sub-tribe *Endomyaria* Stephenson, 1921

Family ACTINIIDAE Gosse, 1858

Genus *ANEMONIA* Risso, 1826

5. **Anemonia indicus** Parulekar, 1968

Genus *BUNODOSOMA* Verrill, 1899

6. **Bunodosoma granulifera** (Leseur), 1817

Genus *ANTHOPLEURA* Duchassaing & Michelotii, 1860

7. **Anthopleura midori** Uchida, 1958

8. **Anthopleura asiatica** Uchida, 1958

9. **Anthopleura pacifica** Uchida, 1958

Genus *PARACONDYLACTIS* Carlgren, 1934

10. **Paracondylactis indicus** Dave, 1957

Genus *ACTINIOGETON* Carlgren, 1938

11. **Actiniogeton sultana** (Carlgren), 1900

Genus *CRIBRINOPSIS* Carlgren, 1921

12. **Cribrinopsis** sp.

Sub-tribe *Acontiaria* Carlgren, in Stephenson, 1935

Family ACONTIOPHORIDAE Carlgren, 1938

Genus *ACONTIOPHORUM* Carlgren, 1938

13. **Acontiophorum bombayensis** Parulekar, 1968

Family METRIDIIDAE Carlgren, 1893

Genus *METRIDIUM* Oken, 1815

14. **Metridium senile** var. **fimbriatum** Verrill, 1865

Family AIPTASIIDAE Carlgren, 1924

Genus *AIPTASIA* Gosse, 1858

15. **Aiptasia** sp.

Family AIPTASIOMORPHIDAE

Genus *AIPTASIOMORPHA* Stephenson, 1920

16. **Aiptasiomorpha luciae** (Verrill), 1899

Family DIADUMENIDAE Stephenson, 1920

Genus *DIADUMENE* Stephenson, 1920

17. **Diadumene schilleriana** (Stoliczka), 1869

## DESCRIPTION OF SPECIES

1. **Edwardsia tinctrix** Annandale, 1915 (Plate I, Fig. 1)

*Occurrence :* Burrowing, solitary and rare form found in soft mud at Cuffe Parade.

*Remarks :* Specimens measure 18-20 cm. in length. Column and tentacles dirty-white in colour. 8 longitudinal rows of nemathybomes

on a worm-like column. Ampullaceous, physa-like base. 16 tentacles in two cycles.

*Distribution :* India—Chilka Lake and Bombay.

2. **Metapeachia tropica** (Panikkar, 1939) (Plate I, Fig. 2)

*Occurrence :* Quite common on all sandy shores but abundant at Chaupatty. Burrowing. Holes round and smooth in clean sand.

*Remarks :* Elongated column, measuring 30-300 mm. in length, with adhesive papillae. Base tapering to a point. 16 tentacles and 5 lobed conchula. Column, milky white, whereas tentacles, oral disc and conchula are spotted.

*Distribution :* India—Krusadi Island, Madras Coast, and Bombay.

3. **Pelocoetes exul** Annandale, 1915 (Plate I, Fig. 3)

*Occurrence :* Very common in soft mud at Secretariat Foreshore, Chaupatty, Versova, Madh and Manori. Solitary forms also found attached to submerged structures and to the tubes of the polychaete, *Polydora coeca.*

*Remarks :* Long, vermiform column, divisible into distal short capitulum and proximal elongated scapus. Blunt tapering base, without physa. Longitudinal rows of nematocyst batteries alternating with cinclides on the column. Branched tentacles and lobed oral disc. Anemone light-green in colour and measuring 40-85 mm. in length.

*Distribution :* India—Gangetic Delta, Calcutta, Madras, Cochin Backwaters, and Bombay.

4. **Phytocoetes gangeticus** Annandale, 1915 (Plate I, Fig. 4)

*Occurrence :* Found together with *P. exul* but less common.

*Remarks :* Narrow physa-like base. Column smooth with cinclides. Unbranched tentacles. Anemone light pink or light green in colour. Length, 60-80 mm.

*Distribution:* India—Gangetic Delta, Calcutta, Madras, Cochin Backwaters, and Bombay.

5. **Anemonia indicus** Parulekar, 1968 (Plate I, Fig. 5)

*Occurrence :* Adhesive, solitary to gregarious forms attached to rocks, or oyster shells or to the tube of the polychaete, *Onuphis* sp. or to the shell of the mollusc, *Coecella* sp. or even to the submerged pier-wall. Found in abundance at Cuffe Parade, Mahim, Mazagaon Docks and Madh.

*Remarks :* Small anemone with a wide pedal disc and a pillar-like column bearing marginal spherules. Column green with brown longitudinal stripes, long tentacles, in 4-5 cycles with V-shaped green or

brownish marks, alternating with white patches. Radial and transverse brown stripes on the oral disc.

*Distribution :* India—Bombay and also at Ratnagiri, Malvan and Redi in the Ratnagiri District of Maharashtra State.

6. **Bunodosoma granulifera** (Leseur, 1817) (Plate I, Fig. 6)

*Occurrence :* Rare and solitary forms living in the deep fissures of rock at Cuffe Parade and Breach Candy.

*Remarks :* Strong, adhesive circular base, pillar-like, pink column with longitudinal rows of nematocyst batteries. Anemone measures 20-30 mm. in length. Tentacles, light pink with red longitudinal stripes.

*Distribution :* West Indies—Jamaica, Puerto Rico, Bahamas, Barbados, Curacao, Guadeloupe, Martinique and St. Thomas. India—Bombay.

7. **Anthopleura midori** Uchida, 1958 (Plate I, Fig. 7)

*Occurrence :* Abundantly found attached to rocks or under surfaces of boulders at Cuffe Parade, Chaupatty (Band Stand) and Manori.

*Remarks :* Small, blackish-brown anemone, with broad base and cylindrical column. 96 rows of light-green verrucae on the column. Pieces of shell often attached to column. Grey tentacles and dark brown oral disc. Length of the anemone 10-15 mm.

*Distribution :* Japan—Mutsu Bay and from Hokkaido to Kyushu. North America—Atlantic and Pacific coasts. Northern Europe and India—Bombay.

8. **Anthopleura asiatica** Uchida, 1958 (Plate I, Fig. 8)

*Occurrence :* Found only at Chaupatty, firmly attached to rocks or oyster shells, in shallow rock-pools. Not very common.

*Remarks :* Greyish-green, pillar-like column with a circular basal disc. Only 12 out of 48 longitudinal rows of red to reddish-brown verrucae on the column, are clearly seen. Column bell-like, when contracted. Acrorhagi in big specimen. Column 10 mm. in length.

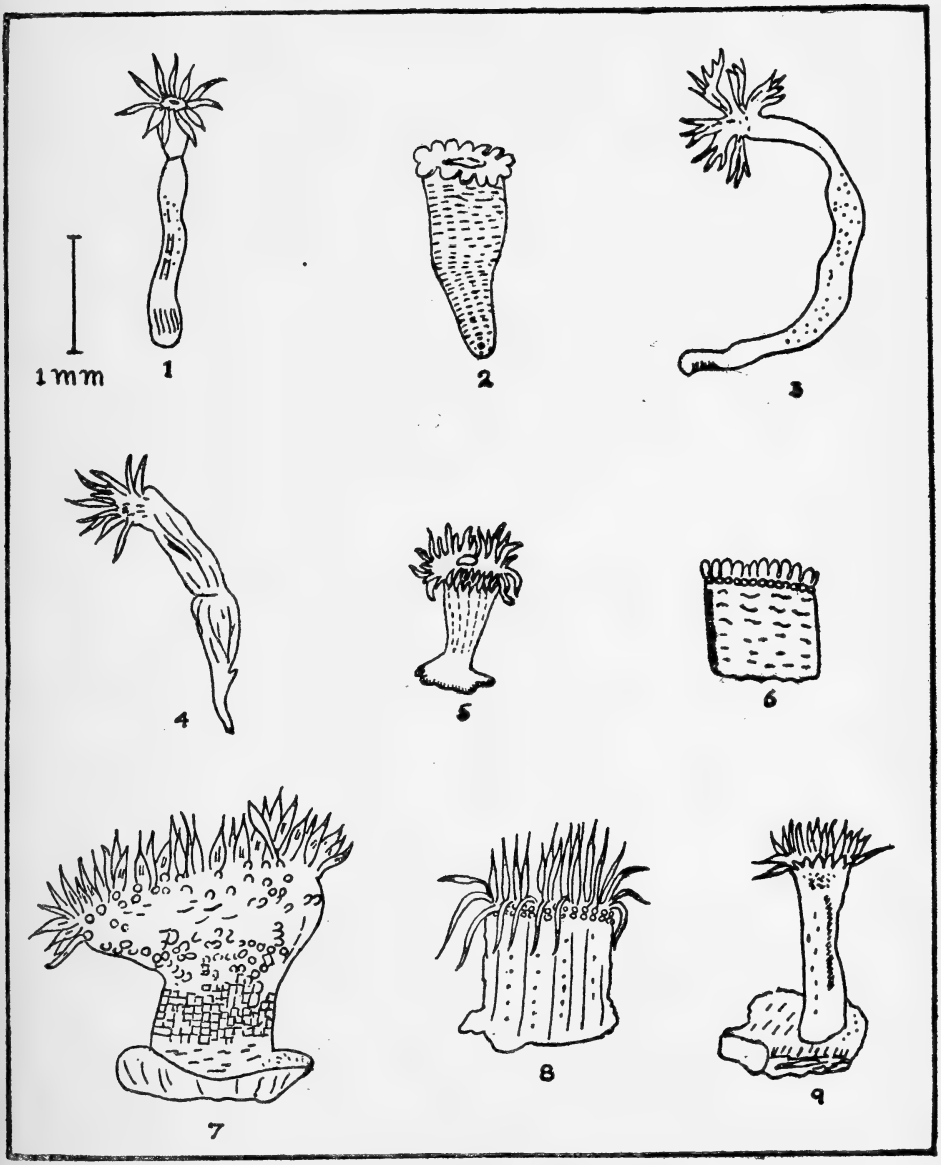
*Distribution :* Japan—Coast of Pacific and Japan Sea from Honshu to Kyushu and in the inland sea near Okayama City. India—Bombay.

9. **Anthopleura pacifica** Uchida, 1958 (Plate I, Fig. 9)

*Occurrence :* Attached to rocks in rock pools at Worli, Mahim and Manori. Gregarious, forming dense colonies with a superficial hexagonal green design due to algae in the oral disc. Not very common.

*Remarks :* Small anemone 10-18 mm. in length with a flesh-like or reddish-brown cylindrical column, ending in a easily detachable base. Verrucae inconspicuous. Slit-like mouth. Oral disc deep green.

PLATE I

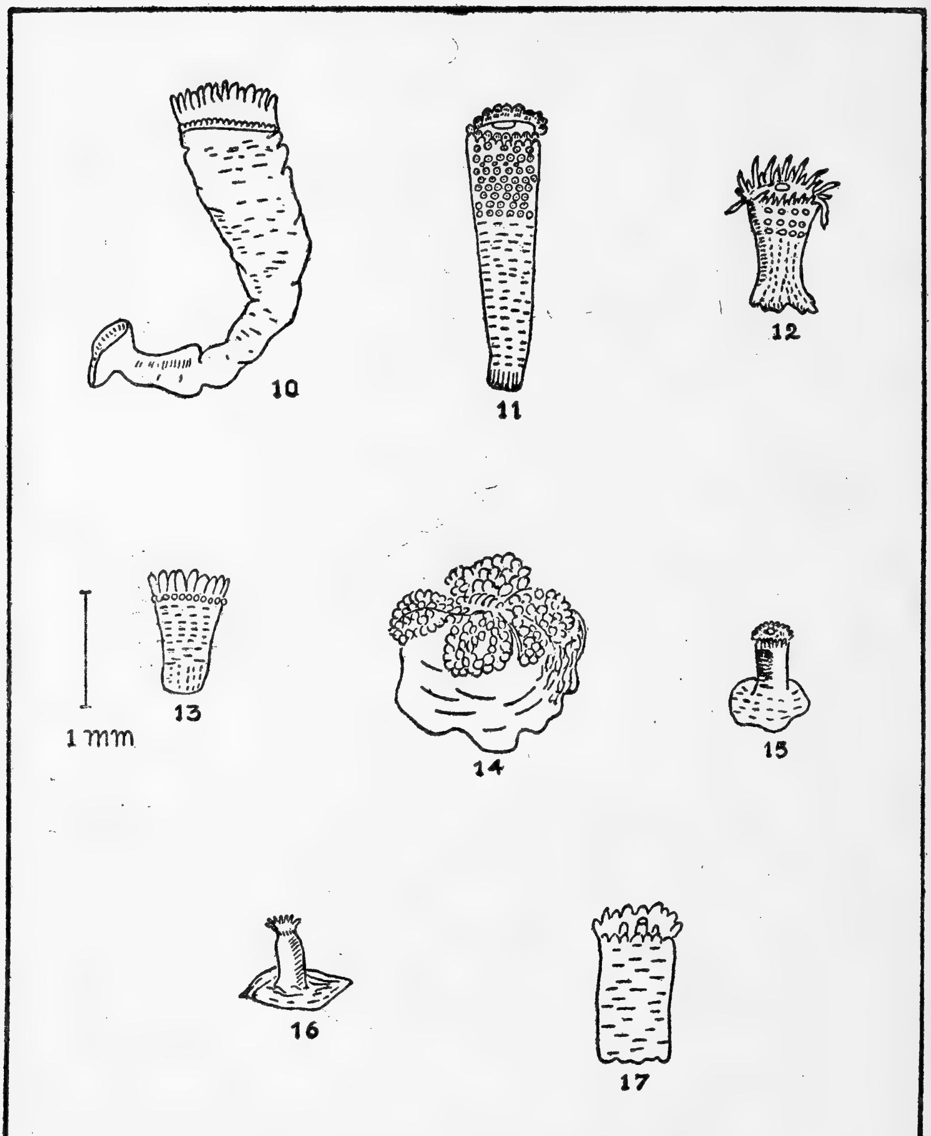



Sea Anemones (Actiniaria) of Bombay : Figs 1-9

1. *Edwardsia tinctrix* ; 2. *Metapeachia tropica* ; 3. *Pelocoetes exul* ; 4. *Phytocoetes gangeticus* ; 5. *Anemonia indicus* ; 6. *Bunodosoma granulifera* ; 7. *Anthopleura midori* ; 8. *Anthopleura asiatica* ; 9. *Anthopleura pacifica*.

Parulekar : Sea Anemones

PLATE II




Sea Anemones (Actiniaria) of Bombay : Figs 10-17

10. *Paracondylactis indicus* ; 11. *Actiniogeton sultana* ; 12. *Cribrinopsis* sp. ; 13. *Acontiophornm bombayensis* ; 14. *Metridium senile* var *fimbriatum* : 15. *Aiptasia* sp. ; 16. *Aiptasiomorpha luciae* ; 17. *Diadumene schilleriana*.

Irregularly arranged tentacles which are greenish on oral and flesh-coloured on aboral side.

*Distribution :* Japan—Hokkaido, Mutsu Bay and Southern part of Korea. India—Bombay.

10. **Paracondylactis indicus** Dave, 1957 (Plate II, Fig. 10)

*Occurrence :* Abundantly found at Secretariat Foreshore, burrowing singly, in mud puddles. Also found at Cuffe Parade and Chaupatty. A crab, *Thalamita crenata*, is usually found in association with this species.

*Remarks :* Reddish-orange, elongated and tapering column, measuring 60-500 mm. in length. Pseudospherules on the column. Presence of a distinct flattened pedal disc. 96 tentacles arranged in 5 cycles. Tentacles and oral disc white to colourless.

*Distribution :* India—Bombay.

11. **Actiniogeton sultana** (Carlgren, 1900) (Plate II, Fig. 11)

*Occurrence :* Rare, solitary and burrowing forms, usually found in sandy mud at Cuffe Parade and Secretariat Foreshore.

*Remarks :* Column 70-160 mm. in length and white to pale yellowish or pink in colour. Distal $\frac{1}{4}$ of the column is covered with longitudinal rows of verrucae to which are attached sand particles and shell fragments. Narrow, physa-like or flat, weakly adhesive basal disc, yellowish-white in colour. Dark transverse bands on the inner surface of tentacles.

*Distribution :* Zanzibar and Durban. India—Bombay.

12. **Cribrinopsis** sp. (Plate II, Fig. 12)

*Occurrence :* Attached to oyster shell and to rocks at Chaupatty, Breach Candy, and Manori.

*Remarks :* Light-pink, short column 10-15 mm. in length. Feebly developed, light red to dark red verrucae on the distal one-third of the column. Pseudospherules and acrorhagi on the column. Tentacles and oral disc crystalline white to semi-transparent. Inner tentacles longer than the outer ones. Strongly adherent base.

13. **Acontiophorum bombayensis** Parulekar, 1968 (Plate II, Fig. 13)

*Occurrence :* Adhesive form living in association with wood-boring mollusc, *Martesia* sp. at Madh. Gregarious due to asexual reproduction by pedal lacerations. Uncommon to rare.

*Remarks :* A very small anemone measuring 10-15 mm. in length. Short column, green in colour, divisible into scapus and capitulum. Longitudinal rows of squarish coloured cinclides on the scapus. Oral

disc, broader than the column and green in colour. Tentacles light-pink in colour. Adherent circular base.

*Distribution :* India—Bombay.

14. **Metridium senile** var. **fimbriatum** (Verrill, 1865) (Plate II, Fig. 14)

*Occurrence :* Solitary and rare form, found inside rock-crevices at Cuffe Parade and Manori.

*Remarks :* Well developed, adherent and spreading base. Column, bright or pinkish or light yellowish, with irregularly arranged cinclides. Length of the column 15-25 mm. Presence of readily discharging acontia. Oral disc bright orange with white radial stripes. 4-5 cycles of tentacles, with innermost whorl of blunt thick catch-tentacles.

*Distribution :* North America through Alaska, Kamchatka and Behring Sea to Hokkaido and Honshu in Japan. India—Bombay.

15. **Aiptasia** sp. (Plate II, Fig. 15)

*Occurrence :* Found at Cuffe Parade, Chaupatty and Dadar. Attached to molluscan shells *Babylonia spirata* and *Turritella duplicata*, inhabited by hermit-crabs of the species, *Diogenes custus* and *Clibararius padavensis.* Colour of the anemone same as that of the shell. Abundant during monsoon.

*Remarks :* Strongly adhesive and irregularly flattened basal disc. Column short, undivided and yellowish-brown to dark brown in colour. Distal narrow part of the column with tentaculate margin. Tapering short tentacles, with transverse brownish stripes.

16. **Aiptasiomorpha luciae** (Verrill, 1899) (Plate II, Fig. 16)

*Occurrence :* The anemone lives as a commensal with a gastropod, *Nassarius ornata.* Common at Chaupatty but also occurs at Cuffe Parade and Secretariat Foreshore.

*Remarks :* Specimens 15-30 mm. in length with a strongly adherent spreading base. Column, dark-green with light yellow longitudinal stripes. Cinclides on the distal part of the column. Oral disc light-green. Tentacles, generally retracted, with alternating transverse bands of green and white.

*Distribution :* East coast of U.K., Plymouth, Holland, Busum, Naples, Venice, Suez Canal, Japan, West Coast of N. America, and India—Bombay.

17. **Diadumene schilleriana** (Stoliczka, 1869) (Plate II, Fig. 17)

*Occurrence :* Found attached to drifting material, such as, pieces of decaying timber and empty barnacle shells at Chaupatty, Dadar, Mahim and Madh. Uncommon.

*Remarks :* Small anemones, about 10-20 mm. in length, with a strong adhesive basal disc, with diameter greater than that of the column. Column and oral disc pink to flesh-coloured. Presence of a definite collar between scapus and capitulum. Bright-red actinopharynx. Hexamerously arranged tentacles with innermost cycle of thick and long tentacles.

*Distribution :* India—Chilka Lake, Port Canning, Diamond Harbour, Calcutta, and Bombay.

## Key to the Identification of Sea Anemones of Bombay

**I. Burrowing Forms**

IA. TENTACLES SIMPLE

(i) *Base* : *Physa-like or Rounded*

(*a*) Worm-like, dirty-white anemone. 8 longitudinal rows of nemathybomes on the column. Only 16 tentacles. *Edwardsia tinctrix*

(*b*) Anemone having an elongated light pink smooth column with longitudinal rows of cinclides. 96 tentacles. Acontia present. *Phytocoetes gangeticus*

(*c*) Anemone with distal ⅓ of the column, covered with verrucae. Pseudospherules also present. Specimens white to pale yellowish or pink in colour. *Actiniogeton sultana*

(*d*) Elongated, reddish-orange anemone found in mud-puddle. 5 cycles of tentacles. Pseudospherules on the column. *Paracondylactis indicus*

(ii) *Base* : *Tapering*

(*e*) Elongated, worm-like column bearing minute adhesive papillae. Milky-white in colour. 16 tentacles and 5 lobed conchula. *Metapeachia tropica*

IB. TENTACLES BRANCHED

(*f*) Light green anemone with a tapering blunt base. Longitudinal rows of nematocyst batteries and cinclides on the column. Lobed oral disc with 96 tentacles. *Pelocoetes exul*

**II. Adhesive forms**

IIA. ATTACHED TO ROCKS, OYSTER SHELLS OR SUBMERGED STRUCTURES

(*a*) Blackish-brown anemone attached to under-surface of boulders. Broad based, cylindrical column having 96 rows of light green verrucae. *Anthopleura midori*

(*b*) Anemone having short greyish-green, pillar-like column with reddish-brown verrucae. Acrorhagi in big specimens. Found in rock pools firmly attached to rocks and oyster shells. *Anthopleura asiatica*

(*c*) Gregarious, flesh-coloured anemone with a deep-green oral disc. Cylindrical column with inconspicuous verrucae. Found in shallow rock pools. *Anthopleura pacifica*

(*d*) Anemone found inside deep fissures of rock. Pink, pillar-like column with longitudinal rows of nematocyst batteries. Tentacles, light-pink with red stripes. *Bunodosoma granulifera*

(*e*) Small anemone with distal one-third of the column covered with dark red verrucae. Inner tentacles longer than the outer ones. Pseudospherules and acrorhagi on the column. Attached to rock or oyster shell. *Cribrinopsis* sp.

(*f*) Hour-glass like green column with marginal spherules and broad pedal disc. V-shaped green or brownish marks on the tentacles. Anemone attached to rock, oyster shell, tube of polychaete *Onuphis* sp., shell of *Coecella* sp., or to submerged concrete structures. *Anemonia indicus*

(*g*) Brightly coloured, small anemone living in the crevices of rocks. Pinkish or yellowish-white column, with irregularly attached cinclides and acontia. Bright-orange oral disc. Presence of inner catch tentacles. *Metridium senile* var. *fimbriatum*

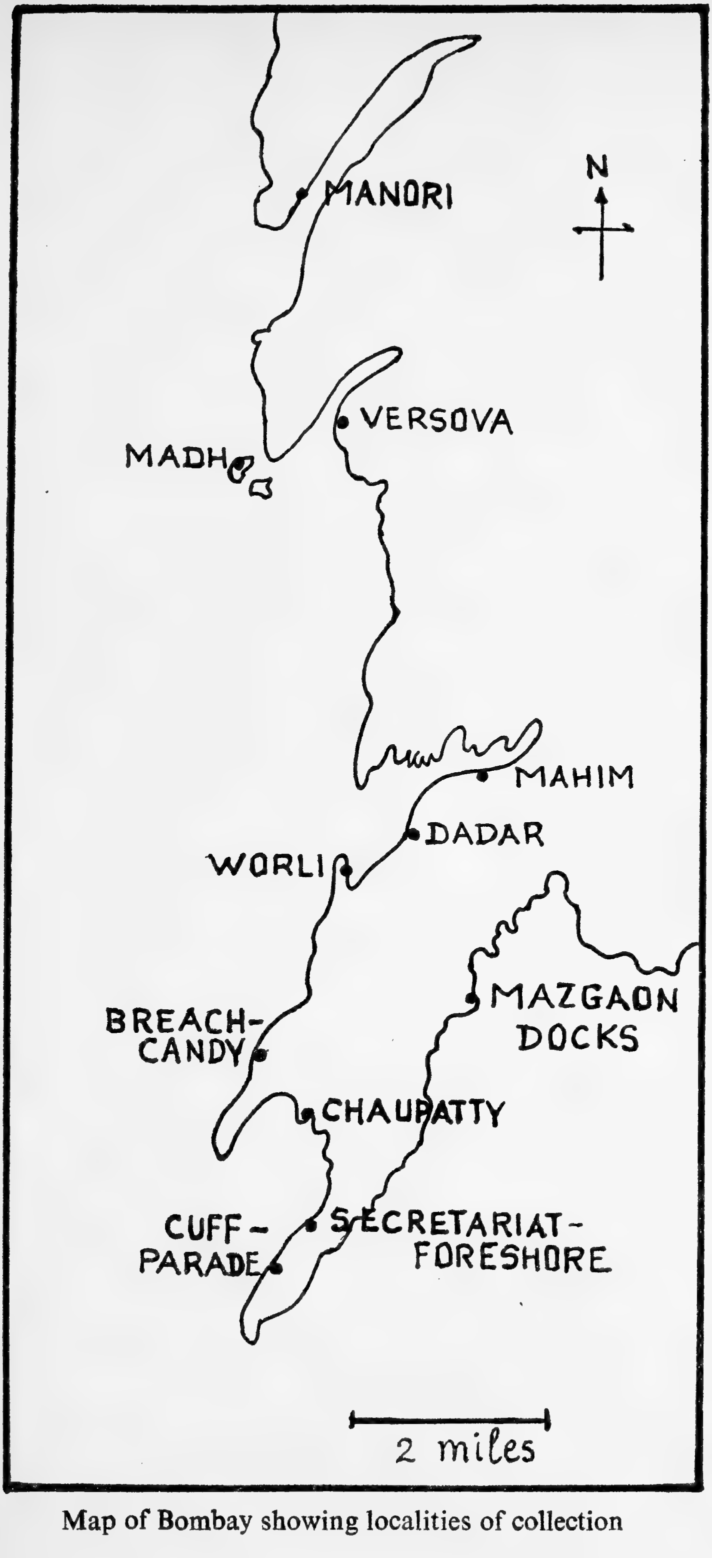
IIB. ATTACHED TO GASTROPOD SHELLS

(*a*) Yellowish-brown to dark brown anemone found attached to the shell of *Babylonia spirata* or *Turritella duplicata*. Circular spreading basal disc. *Aiptasia* sp.

(*b*) Small, light green anemone found attached to the shell of *Nassarius ornata*. Cinclides on the distal part of the column. Irregularly flattened, thin basal disc. *Aiptasiomorpha luciae*

IIC. ATTACHED TO TIMBER IN ASSOCIATION WITH WOOD BORING MOLLUSC, *Martesia* sp.

(*a*) Small anemone in which the light-green column is divided into scapus and capitulum. Longitudinal rows of cinclides on the scapus. Light-pink tentacles. *Acontiophorum bombayensis*




Map of Bombay showing localities of collection

IID. ATTACHED TO DRIFTING MATERIAL

(*a*) Anemone found attached to decaying wood or empty barnacle shell. Pinkish-white column with red actinopharynx. Column divided, by a definite collar into distal capitulum and proximal scapus. Cinclides present. *Diadumene schilleriana*

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# The nesting activities of the vespoid potter wasp *Eumenes campaniformis esuriens* (Fabr.) compared with the ecologically similar sphecoid *Sceliphron madraspatanum* (Fabr.) (Hymenoptera)

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(*With two figures*)

[*Continued from Vol.* **64** (2) : 332]

## Daubing

All individuals of both species added a number of loads of mud to their constructs after they had completed and sealed a cell. These can be classified in various ways. In our previous paper on *m*l we used the word *daubing* and often used the metaphor 'roughcast'. Other authors have adopted Roubaud's (1916) word *crépissage* which may be translated by roughcast, but has been adopted into entomological literature in English because it has a wider range than any translation. In this paper we are using both words and giving them separate meanings. Crépissage in the present sense is only constructed by *esuriens* and other species of *Eumenes* that we have seen Jayakar & Spurway (1965). Its structure is physically different and, as shown in Table 11, it is worked at a different tempo from the daubing proper which is similar in form in both species, and it is laid down in a special context. Crépissage will be considered more fully in the next section.

All wasps observed, when they had sealed a cell, laid down some loads of mud not clearly associated with the lid or with the site of the next cell. These loads were carried and put down in the manner characteristic of the species. The *madraspatanum* wasps first put down the loads and gradually spread them out so that their final form was like a little cow-dung cake drying on a wall for fuel. The *esuriens* wasps again held their loads clear of the construct and spread out the mud

TABLE 11

TIMES SPENT *on* NEST FOR DAUBING VISITS

| | | Usual | | | | Panic | | | Crépissage | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *m*1 | *e*1 | *e*2 | *e*5 | *e*8 | *e*2 | *e*5 | *e*8 | *e*2 | *e*5 |
| no. of timed visits .. | 276 | 55 | 120 | 75 | 74 | 10 | 29 | 25 | 173 | 93 |
| shortest period .. | 9 | 19 | 13 | 14 | 23 | 13 | 22 | 22 | 11 | 15 |
| longest period .. | 129 | 216 | 110 | 144 | 117 | 37 | 83 | 68 | 78 | 56 |
| mean .. | 27·18 | 67·11 | 39·37 | 53·69 | 63·58 | 24·00 | 40·62 | 41·96 | 28·44 | 34·12 |
| s.e. mean .. .. | 0·90 | 3·91 | 1·45 | 3·13 | 2·25 | 2·27 | 2·76 | 2·69 | 0·73 | 0·93 |
| median .. .. | 23·70 | 65·75 | 37·00 | 52·00 | 66·00 | 24·00 | 39·00 | 40·67 | 27·40 | 32·75 |
| s.e. (1) median .. | 0·46 | 2·32 | 1·68 | 1·91 | 2·00 | 4·11 | 2·61 | 2·65 | 1·05 | 1·35 |
| s.e. (2) median .. | 0·66 | 3·55 | 1·54 | 3·51 | 2·66 | 3·75 | 3·15 | 3·69 | 0·93 | 1·09 |
| IQR median .. .. | 47 | 43 | 49 | 63 | 37 | 53 | 47 | 49 | 48 | 34 |
| C.O.V. % .. .. | 55·1 | 43·2 | 40·4 | 50·5 | 30·5 | 29·9 | 36·7 | 32·0 | 33·6 | 26·3 |

from only that part of the load with which the construct had been touched, so that one load was frequently divided between several sites.

In both species daubs were usually placed in chinks between two cells, and between cells and the substrate, and their function could often be appreciated. However, the number of such loads put down by members of both species was very variable. Sometimes only one or two such loads were brought between building two cells and the daubs made with these would be quite inconspicuous in an excavation of the finished nest. The wasps *m*3, *m*4, and *m*5 made few daubs before making the foundations for the next cell. The result of variation in the number of loads put down seems similar to a nest variation reported by Roubaud (1916) in the Vespoid which he calls *Synagris callida* L. but which Wheeler (1923) states is correctly *S. spiniventris* (without an author). The nest made by *m*1 corresponded accurately to Roubaud's description of a *compact* nest in that species, whereas *m*3, *m*4, and *m*5 made what would be called *dissociate* nests. This difference, which we regard as quantitative, Roubaud believes to be determined by the consistency of the mud used. Wasps *e*1, *e*2, *e*5, and *e*8 also differed similarly among themselves, only *e*2 resembling *m*1. Their daubs were spread much thinner and more smoothly blended with each other and with the previous construct than those of *madraspatanum*.

While daubing, both species of wasps put loads of mud, not only on the construct, but also on the surrounding substrate. The working of these loads was, for both species, quite deliberate, but quite different, and in both the function is at best controversial. Wasps *e*2 and *e*5 occasionally, and late in their work, laid down a load either entirely separate from the main part of the construct or as discrete patches or blobs extending out from it. These may be considered as the beginning of crépissage and will be considered later. They were also made by less systematically watched wasps. On the other hand, *madraspatanum* wasps spread out mud with movements indistinguishable from those with which they made foundations but in regions where cell walls could not have been built without occluding the opening of previous cells. Some of such *smoothings* by *m*3 did not join the cell block ; Dutt (1913) has also described these. They may have a camouflaging function (Horne 1872).

We have so far considered daubing (in our sense) and associated activities that were performed after a cell has been closed. These may be called *in phase* daubing. Concerning *out of phase* daubing, *m*1 only daubed one load at any other time and this was between two loads used to make cell walls and was related to the walls of the cell being built. The *esuriens* wasps more frequently alternated daubs and walls at the beginning of a cell. These daubs are considered to be part of the series of *in phase* daubing which had preceded the wall building. However the

*esuriens* wasps appear to daub at least two other times, and under other stimuli. Wasp *e*1 followed oviposition in the two cells we watched with a period of daubing before provisioning which did not extend on to the newly built cell. These were calm and though each was preceded by a relatively long absence and at least one loadless inspection, they seemed to have the same function as the daubs she added after sealing, and in Table 11 and Fig. 9, are grouped with these. Secondly, *e*2 produced one period of work, *e*5 two, and *e*8 three which might be called *panic daubtng.* We do not know what evoked this from *e*2 but her behaviour left little doubt that she was dealing with a crisis. After inserting the fourth larvae into her cell V, *e*2 did not leave, but hovered and landed twice. She then brought ten loads of mud most of which she put down on the two most recent cells. She worked more quickly than previously (Table 11 and Fig. 9) and also deposited water on the construct while doing so. She then resumed provisioning cell V. Judging by this behaviour, it seemed that the crisis was caused by the construct becoming defective. Over two and a half hours before, while building cell V, *e*2 had spent an unusually long time feeling the construct.

On the two occasions when *e*5 daubed *out of phase*, the wasp was almost certainly aware that another insect had been near the nest in her absence. Similar incidents preceded the final closing of nests of this and other species (Jayakar & Spurway 1965, and below). Therefore we suggest that the presence of an enemy stimulates or releases this activity. This is suggested by the following observation: On 19/10, an individual of *Chalybion bengalense* landed on the construct and swept the newly finished mouth of cell *e*5 IX with its antennae for four seconds before flying away. It thus can be assumed to have left some scent on the nest. However *e*5, who was first noticed 113 seconds later, and who approached hesitatingly, and from an unusual direction, may have seen it on the nest. After appearing reluctant to land, *e*5 landed and examined the nest for over 5 minutes, left for over half an hour, returned without a load, and examined for 6 minutes. She then daubed 16 loads followed by an inspection visit and left for the day. Next morning, after the first loadless inspection visit, she provisioned cell IX normally.[1]

On 24/10, while *e*5 was making the neck and lip of cell XII after nearly an hour's delay due to rain, a blue-green cuckoo wasp of the family

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[1] Our interpretation of this behaviour of *e*5 suggests that *C. bengalense* has, for potter wasps, some stimuli similar to those produced by chrysid cuckoo wasps. The closely related *C. californicum* is believed to open cells of *Sceliphron cementarium* and remove the wasp larvae and provisions before using the cells for rearing its own young (Meeusebeck *et al.* 1951, Evans 1963). *C. bengalense* is certainly a squatter, and we have seen individuals empty the provisions out of holes in wood recently filled by themselves, by other members of their own species, and by other squatters. Vespoid squatters also behave similarly. *C. bengalense* also collects mud for sealing its own cells from the nests of potter wasps and om the lids of squatter wasps, and may, therefore, open their cells while these are still occupied.

Chrysididae examined the abortive foundation built by *m*2 27 days before. This smear of mud was about 48 cm. vertically above cell XII of the nest of *e*5. The chrysid was chased away by the observers before *e*5 began ovipositing. After this, instead of provisioning, she immediately daubed 13 loads of mud before work was interrupted by failing light.

As for *e*8, we are unable to understand why she daubed out of phase when she did. On 17/4/63, in the middle of making the walls of cell VIII, she put down 6 daubs in several different places. Then, on the next day, having finished her cell IX and laid an egg in it, she left at 11.56.51. At 13.27.36 she returned without a load, inspected for 74 seconds, and then fetching mud in another 242 seconds, she had a spell of daubing during which she brought 10 loads of mud. The only other visit she paid to the nest that afternoon was an inspection visit. There was some rain that afternoon. On 20/4, also, after ovipositing in newly finished cell XI, she left at 13.48.43. At 14.26.42 she returned loadless, inspected for 103 seconds, was away for 582, at the end of which she brought 7 loads of mud which she daubed, then remained away for 3133 seconds, returned loadless, inspected for 140 seconds, made 4 more daubs, remained away for 2929 seconds, returned loadless for 32 seconds, then daubed 4 loads and left for the day at 16.47.45. During this panic daubing, the clouds had been increasing.

Table 11 and Fig. 9 (below) make clear that all wasps increased their speed of work while panic daubing, and where data are available, i.e. for *e*2 and *e*5, these speeds were not significantly different from those at which they built their final crépissage. Three *esuriens* (*e*13, *e*22, *e*23) made structurally unmistakeable crépissage before returning to cell construction. We do not know the contexts in which this was made.

## The final form of the constructs including Crépissage

Column 10 of Table 1 describes the condition of the material construct when the nest was left. For many nests we have evidence, either direct, or from the accumulation of prey, that the wasp had visited the construct after the last load of mud had been deposited. This is the date entered in column 9 of Table 1 and used in constructing Table 9. From these data, we find that 2 or 3 *esuriens* and 3 *madraspatanum* wasted some labour and at least 12 *esuriens* and 2 *madraspatanum* not only wasted labour but left an offspring partially or completely unprovided for. A young wasp in an unsealed cell is not certain to perish, though *e*16 I was both abnormally small and unable to emerge from its pupal skin. Wasp *e*9 I, unfortunately, was killed 24 hours after emergence from the pupal skin. At the time it was judged to be deformed but

the observation made later that *esuriens* imagines do not assume their adult posture until at least 36 hours after emergence from the pupa makes this interpretation almost certainly erroneous.

Before we discuss whether these 19 desertions are to be considered involuntary, i.e., the mother being prevented, probably by death, from returning to the construct, we will consider how the remaining 11 nests were left. They were all constructed by *esuriens.* In 5 (*e*7, *e*13, *e*15, *e*19, *e*24) the last cell was sealed, and in some certainly daubed a little in the way previously described. The remaining six *esuriens* (*e*2, *e*4, *e*5, *e*6, *e*14, and *e*22) made the qualitatively different style of daubing to which we wish to restrict Roubaud's (1916) term *crépissage.* This structure was begun by all except *e*4 and *e*14 only after the sealing of a cell ; in these two it was begun while a cell was not only unsealed but completely unprovisioned containing only the suspended egg, so these two individuals must be added to the previously mentioned 19 who wasted labour and abandoned an offspring. The wasps observed built their crépissage by working with increased intensity, fetching mud more quickly (Fig. 9 below), working it more rapidly on the nest and, at the end, hardly spreading it out at all. Table 11 compares the various types of daubing for the different wasps with regard to time spent on the nest while working a load. *e*2 and *e*5 also divided a single load between more and more sites, the maximum being five. Therefore finished crépissage has a crumbly or granular surface and must have a porous consistency (compare Fig. 7 with Fig. 8). The wasps also made ribbons of mud on the substrate. These were slightly ruched and resembled the ribbons made by pushing the paste made of icing sugar through a funnel while decorating a cake. These ribbons were often continuous with ridges over the cells, but some were entirely separate from the main construct. The wasps also constructed vaults extending over many cells. These were constructed from ridges and ribbons which were added to so that they curved over enclosing a considerable amount of space. A vault could be constructed from one, two, or three ridges joined up in an elaborate manner which was sometimes symmetrical and sometimes not. The open lips of the last cell of *e*4 (IX) were joined up and made continuous with this vaulting, as were those of cell *e*22 VII which had not been destroyed when the cell was sealed, perhaps precisely because the wasp had determined to build crépissage immediately afterwards. Iwata (1942) considers these vaults to be an adaptation to minimise fluctuations of temperature within the cell by surrounding it with an air jacket. We suggest that they may also provide a defence against cuckoo wasps. Wasp *e*14 put on two complete layers of vaults, and included her open cell within them whereas *e*2 and *e*5 only made one small vault each.

We have compared such a completed crépissage (Jayakar & Spurway 1965b) to a miniature chain of recent mountains with smaller ridges

extending from a central spine. Only four wasps (*e*2, *e*5, *e*6 and *e*14) closed their vaulting, and the first three of these, to continue the mountain metaphor, built up the peak over their youngest cell (which, only in nest *e*5, was the highest vertically) into a little pinnacle approximately 1 cm. high, and therefore somewhat destroying the resemblance of the construct to a mountain range by being so grossly out of proportion. In detail this pinnacle resembled a small cairn of stones, the mud balls of which it was made being barely worked into one another at all. The function of this cairn is unknown. Wasp *e*5 almost invariably landed on hers once it was constructed. We have seen no comparable structure to this cairn constructed by *E. emarginatus conoideus* or *E. p. pyriformis* (Jayakar & Spurway 1965b).

The only *esuriens* for whom we have data (*e*5), fetched all the mud for her crépissage from the same source as she used for her cell walls, and the colour of the crépissage of the other nests confirms that, for our population at least, this is so far the rule. In this *esuriens* again differs from *conoideus* and *pyriformis,* who in our experience have completed, almost decorated, their crépissage with material of a different colour and consistency from the material of which their cells and the bulk of the former were made. Finally, *e*5 and *e*22, who were still working on their crépissage when their earlier cells were due to emerge, left these earlier cells uncovered. We have recorded the same omission by *conoideus* (Jayakar & Spurway 1965b).

As a routine we continued watching the nests of *e*1, *e*2, *e*5, and *e*8 during the hours of daylight until the wasp had failed to return for 24 hours (20 hours 24 minutes for wasp *e*2). We thus watched *e*2 and *e*5 withdraw from their constructs after they had finished building them to their own satisfaction. Their remaining visits were loadless and are given below :

| *e*2 | | *e*5 | |
|---|---|---|---|
| away | on | away | on |
| 256 | 10 | 10621 | 4[1] |
| 4856 | 2 | 4183 | 13 |
| 8833 | 10 | 76086[2] | 27[3] |
| 73462[2] | watching discontinued | 87644[2] | watching discontinued |

[1] hovered over sill before leaving.
[2] including a night.
[3] including hovering over nest.

The function of these returns after long intervals (also recorded for *conoideus* and *pyriformis*) is not obvious ; perhaps they have no function and are the inescapable consequence of the evolution of *both* a memory and a positive reaction to the nest, neither of which disappears abruptly.

The capacity to make these visits may make various adjustments possible in rare catastrophes, and it may have important evolutionary significance.

If we consider closed vaults, and perhaps a cairn, as evidence for a completed construct, we imply that no *madraspatanum* and only 3, or perhaps 4, *esuriens* completed their constructs, though it is probable that *e*22 would have done so if the nest had not been dissected on 18/6/64. Beginning with the animals we watched at work, we will consider the circumstances that stimulate a wasp to cease cell building and begin crépissage, and discuss the evidence that similar stimuli may precipitate desertion.

After *e*1 had left, having put down her second load of mud onto her cell IV, a chrysid cuckoo wasp landed on the nest. She was attacked by *e*1 and they both flew off together. The cuckoo returned and laid an egg through the wall of cell II with the mother hovering over her. The movements of *e*1 were frightened, not aggressive. The two wasps then left together but the cuckoo returned in 6 seconds and inserted her abdomen. *e*1 returned in 198 seconds but was temporarily prevented from reaching the cells by an unsuccessful attempt to catch the cuckoo. The cuckoo left, returned, and put her ovipositor into I. When the chrysid left, *e*1 returned. We do not know if she had been around all the time. She inspected the cells for 11 seconds. She returned two more times for 8 seconds and 2 seconds after intervals of 15 and 27 minutes respectively bringing no loads, merely inspecting the cells. After an hour, a chrysid of the same species again appeared on the cells. That she concentrated her attention on cell III does not prove she was the same individual, as she could perhaps have recognised, by the visible little pits in their walls, that cells II and I had already been parasitized. She laid in III, and was captured. Nearly half an hour later, i.e. after she had been away 50 minutes, *e*1 returned again without a load and inspected for 5 seconds. She did not return during the next 24 hours of daylight, i.e. she apparently deserted because all her cells had been parasitized.

The panic daubing performed by *e*2 during provisioning of cell V has previously been described. On the same day, after sealing cell V she immediately made an inspection visit and then brought 15 loads of mud, 14 of which she daubed during periods on the nest ranging from 14 to 32 seconds. The last load she dropped, most probably because she saw the approach of a chrysid. This cuckoo was most persistent in her attempts to lay but was finally captured by us. *e*2 returned with mud and it was soon after realized that her building was different from any previously seen. Though between sealing one cell and beginning the next, *e*2 always made more than 20 daubs, usually more than 30, the speed with which she worked the 14 daubs immediately after sealing V suggests that these were crépissage daubing. If this is correct, the

beginning of this crépissage was not stimulated by the presence of the cuckoo. The decision to close the nest may have been due to the stimuli that provoked the panic daubing during the morning.

On two occasions when *e*5 brought larvae to cell XIII, a striped fly, probably a sarcophagine and similar to those which parasitized *e*8 and *m*3, followed her across the verandah and settled on the window sill facing the nest. As soon as *e*5 had left, the fly flew to cell XIII and put its head in. On both occasions it was disturbed by the observers. On neither occasion did *e*5 do any feeling that could be interpreted as reacting to the fly's foot prints as she had reacted to the *Chalybion* 14 days before (p. 151). However, after the second occasion she made an inspection visit, sealed her cell and began her crépissage, again immediately, judging from her speed of work. Wasp *e*5 roughcasted the earlier cells very much less than the later so that their surfaces remained smooth and only the upper half of the construct assumed the crumbly texture (see Fig. 8). This seemed a deliberate response to the demands of the situation. Is it possible that the wasp knew that her earlier cells contained offspring too advanced to be vulnerable to parasitization? Or, to use a somewhat pedantic jargon, why did these early cells not provide the stimuli for crépissage or, alternatively, provide stimuli inhibiting it. The first emergence, that from cell II, took place while this final roughcasting was being performed.

Wasp *e*8, who had not reacted to the presence of a fly which, on 17/4/1963, had successfully oviposited, or perhaps larviposited in cell VII, deserted on 21/4. On 20/4, she oviposited in cell XI at 13.48 after completing the building of that cell. At 14.26 she returned without any load, which in itself was not surprising, but what followed was. She spent 103 seconds feeling the construct, than left, and returned after 582 seconds with a load of mud and daubed it on the construct. She brought 7 such loads and was then absent from 14.48 to 15.40 when she again came without a load. This time she spent 140 seconds on the construct of which she spent 63 seconds absolutely quiet with her head over the mouth of cell XI. She left and then returned for a second stretch of *out of phase* daubing. This time she brought 4 loads. She was absent from 15.50 to 16.40 when, after another inspection of 32 seconds, she did some more daubing (4 loads). The next day she started work at 07.35. She brought 2 larvae, made one inspection and then brought a third larva (at 11.41), until that time behaving quite normally. It was only when she brought her fourth larva that we noticed any change in her behaviour. After putting this larva in within 5 seconds of her arrival, she spent 736 seconds on the construct, for 638 of which she stood over cell XI, quiet except for opening and closing her wings. She left at 11.53, brought her next larva in 154 seconds, spent 168 seconds on the nest, flew away rather suddenly at 11.58 (perhaps frightened by a

house sparrow), returned at 12.44 without a load, and spent 50 seconds on the nest. She returned again with a larva at 14.40, spent only 9 seconds on the nest, and that was the last we saw of her. What the reason, or reasons, were for this unusual behaviour we do not know, but once again desertion was preceded by a marked disruption of the wasp's usual sequence of activities. It is possible that there had been parasitization by an organism such as a chalcid too small for us to notice its entry.

Concerning the *esuriens* nests watched in less detail, we know nothing about the desertion of the nests built by *e*7, *e*9, *e*10, *e*12, *e*13 (who had made some crépissage before returning to pot building), *e*16-21, *e*23 (perhaps interrupted by observers because emergence had begun), or *e*25. The last certain visit of *e*11 was followed by six days of almost continuous rain, and though *m*4, building at the same time, returned and continued her nest, it is not surprising that any given wasp failed to do so after so long an interval.

For the others we have some observations which will now be listed.

Wasp *e*3 built one cell, presumably laid in it, and inserted at least three larvae, one a caterpillar and one an apodous larva. Within three minutes of the mother leaving the nest, ants had begun to remove these larvae. They also apparently removed the egg. The wasp was never seen at that site again. It is surprising that other nests were not similarly plundered as there were several ant colonies on the same verandah and individual ants ran in and out of several cells.

Between 11.28 and 11.43 on 11/10/62, cell VIII of *e*4 was sealed and two beginnings of cell IX were made. The second of these was completed and laid in at 12.01. During this building, a chrysid was seen flying in the hole in the parapet. It did not land. At 12.03, *e*4 returned with mud which she put between cell VIII and the just finished definitive cell IX, beginning her crépissage with a vault. An hour later, *e*4 had laid out rows of mud on the wall separated from the cells, and begun to build these up into vaults. At 13.27 a chrysid was found ovipositing, watched by *e*4. Both wasps settled and inspected (not together) and *e*4 only resumed building at 13.33. At 15.43 a chrysid was again laying, again watched and not disturbed by *e*4; *e*4 was not seen again and no further mud was added to her construct. A third egg was laid by a chrysid next morning at 08.08. When the nest was deserted the nine cells were almost covered by a series of overlapping vaults. *e*4 was working on the already continuous edge of the only open hole when the first two chrysid eggs were laid. They were laid within this hole, i.e. into cells and not through the vault roofs into the empty spaces in the crépissage. The overlapping vaults of the crépissage were smooth on the outside and resembled closely the overlapping cells whose contours they masked. Cell IX had not been sealed and the false walls had been joined onto its lip. One vault cut

across the abandoned half-built cell IX, one of its brackets being enclosed and one left outside.

Wasp *e*6 was painted at 14.38 while building her cell II. She stopped the moulding she was doing, left, and brought no more mud until 09.03 next morning. Though at 10.16 the cell was found completed, she was found ovipositing in it at 11.02. At 12.02 she was sealing this cell and by 14.02 had completed her crépissage, which contained little vaulting. This was extremely rapid work, and the wasp that emerged from cell II was small.

Wasp *e*14 was exposed to both stimuli. At 12.58 she was painted on the abdomen while making cell walls. She had finished that cell (VIII) by 13.18 and was daubing. At 14.11 while she was still daubing a chrysid was hovering over the nest, and by 14.41 the crépissage was in an advanced stage with an elaborate series of vaults begun. Though these vaults were closed the same evening, the wasp added to her crépissage next morning but left without adding a cairn.

The nest of *e*15 was only discovered at its moment of desertion when the presumed mother was watching a chrysid depositing her eggs. No further additions were made to the nest.

Wasp *e*22 was captured while daubing at 13.29 on 14/6 and painted under ether. On the morning of 15/6 she constructed some crépissage including a vault before building her next cell (VII). This she did not seal until 17/6, and when this was discovered, crépissage was already begun and a chrysid was laying in the construct having made at least six holes. On the morning of 18/6 the construct was dissected because the wasp from cell I had emerged. The vaults were not yet closed and, as *e*22 was working late the previous afternoon, it is probable that she would yet have completed them if she had not been interrupted.

Wasp *e*24 hovered while a sarcophagine fly landed and felt the mouth of her cell II on 13/6. She provisioned this cell, built cell III (interrupted in order to etherise and paint), provisioned and closed it, and deserted. When found, all three cells had the small pits left by chrysid oviposition, mud had been dug out of the nest walls, and a mud load was lying near, as though dropped by *e*24 while agitated.

From these anecdotes, we consider both that the wasp's behaviour is altered by stimuli provided by the parasite (or perhaps labour parasite), and by her egg holes, and that one very important function of the crépissage is protection from such parasites. The presence, or past presence, of a parasite to which a wasp visibly reacted, stimulated her to cease work on her cells, sometimes abruptly, sometimes after the next closure, and to consolidate those she had already sealed. The overlapping walls of the vaults in the crépissage completely obscure but *mimic* the overlapping cell walls which they cover, and the spaces within them would trap and starve harmlessly any parasitic egg that was laid into them. Wasp *e*4

did not crépissage cells which had been so parasitized and *e*5, *e*13, and *e*22 (and a *conoideus*) left uncovered their earlier cells in which perhaps pupae were not vulnerable to this form of parasitism, as the full grown larva is known to be. Finally, on those occasions when the observers believed that all cells had been parasitized, the mother wasp showed initial confusion from which she recovered by deserting the construct. The chrysids themselves examined partly finished crépissage. They always laid inside open vaults if possible, and also did not lay inside cells which had already been parasitized, at least by members of their own group. Two species of chrysid, *Stilbium cyanurum splendidum* F. and *Chrysis orientalis* Guer., and the dipteran *Pachyophthalmus auriceps* Baronow have emerged from cells made by *esuriens*.

We have no data which can be used to compute frequencies of parasitization in these species in this locality. Not only have we frequently driven away parasites from nests which we were watching, but the care taken of the nests after they were built was not standardised. Some were caged immediately, some were dissected after varying intervals, while others were exposed until emergence of the oldest offspring had begun, and consequently frequently parasitized long after desertion by the mother.

We have described elsewhere the enigmatical behaviour of *m*1 the morning before she deserted her nest. Wasp *m*3, *m*4, and *m*5 left their constructs in a similar condition and we have no evidence as to what stimulated this. Dutt (1913) states that *madraspatanum* wasps build all their cells and then roughcast the whole group together, i.e. that they make a crépissage. This has not been performed by any of the wasps we have watched, nor have we found any nest presumably of this species in which all the cells were roughcasted[1], and it is rare to find one without evidence of unfinished work i.e. an unfinished or open cell, or one sealed with a concave lid indicating that provisioning was incomplete. We have noticed that the behaviour patterns of these two groups of mason wasps are often confused in the literature, a behaviour pattern peculiar to one being stated to be performed by the other, e.g. by Frost (1959).

Finally, the desertion by *m*2 of a site on which she had not built should be put on record. We have described how *m*2 selected this site. Including her first visit with mud, she made 15 more visits on 27/9/62, on nine of which she brought mud and smeared it on the place she had selected. She disappeared for the day at 12·44. On 28/9 she made 3 inspection visits beginning at 07.59, being away for less than half an hour

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[1] Note added November 1967 : of the 13 individuals of *madraspatanum* in our records, one at Bhubaneswar, *m*7, deserted her construct after covering it with a layer of unusually rough daubing. She was painted, and therefore recognised subsequently. She therefore confirmed Dutt's observation.

between them. She was then away for just over two hours and then returned with a large untidy black load certainly not mud and plausibly a spider. She landed for 3 seconds only, then hovered 3 times approaching her mud, flew the whole length of the verandah and returned leaving from the extreme west. No further visits were paid to the smeared mud. Next day a *S. madraspatanum* was seen examining non-homologous parts of the frame of (5), and an individual was seen again on 9/10.

This last visit of *m*2 (on 28/9) to the mud smeared by her was clearly a *mistake*, and her uncertain movements confirm this. However, was it a failure of memory or the miscarrying of an instinctive cycle? Did she (as a human might) temporarily forget that he had deserted this site and return to it instead of the later chosen site, where (we are suggesting) she had a cell open to receive the prey ; or was she having difficulty finding mud (she took longer to fetch this than *m*1), so her ' building drive ' had been superseded by a ' provisioning-drive ' without the cell being built, and did the traumatic experience resulting cause the site to be abandoned? There is one piece of evidence suggesting the ' failure of memory ' explanation. Before this visit *m*2 was absent 7479 seconds. The longest absence after which *m*1 returned with a spider was 6106 seconds and this was exceptional ; *m*1, at least, behaved as though she was likely to forget the condition of her construct if she was absent for much more than half an hour, and had to make an inspection visit before she could resume work. Therefore we think that *m*2 must have been working at some unknown site during these 7479 seconds.

## Inspections and Memory

All the *esuriens* watched in detail (except *e*8 on 1 occasion) made a loadless inspection visit in the morning before bringing any load. On the one occasion *e*8 did not do so, she had however hovered for 30 seconds in the vicinity of the nest without landing. Chores that did not necessitate a load could be done on these visits, e.g., *e*5 laid eggs on the first visit of a morning and *m*1 removed concave lids, in both cases after prolonged antennal feeling of the construct. Both wasps sometimes performed these chores on a later visit, but in both cases always before any load had been brought during that day.

Apart from these visits, all the wasps made several inspection visits, mainly during provisioning, and *e*1, *e*2, *e*5, and *e*8, between them made only 10 that were during other activities. The times spent away from the nest before such inspection visits and the times spent on the nest during such visits are summarised in Tables 12 and 13. We suggested that these visits made by *m*1 were due to failures of her memory, so that she had to check what her next activity was to be. There is much more overlap in duration between the periods before a loadless visit and one with prey

in the *esuriens* wasps observed (compare Table 6) i.e. on this interpretation they have more variable memories than *m*1, and, as is shown in the tables,

TABLE 12

TIMES SPENT *AWAY* FROM NEST JUST BEFORE AN INSPECTION VISIT

| | *m*1 | *e*1 | *e*2 | *e*5 | *e*8 |
|---|---|---|---|---|---|
| no. of timed absences .. | 82 | 3 | 22 | 25 | 23 |
| shortest period .. | 40 | 1006 | 4 | 7 | 1896 |
| longest period .. | 7018 | 4661 | 6054 | 8027 | 6722 |
| mean .. .. | 1878·5 | 2532·3 | 1403·2 | 3039·9 | 3681·2 |
| median .. .. | 1658 | 1930 | 169·5 | 2756 | 3324 |
| Q− .. .. | 809 | | 8 | 562 | 2743 |
| Q+ .. .. | 2127 | | 2210 | 4134 | 4674 |

Visits after a night absence and visits after desertion of the nest are omitted.

TABLE 13

TIMES SPENT ON NEST INSPECTING

| | *m*1 | *e*1 | *e*2 | *e*5 | *e*8 |
|---|---|---|---|---|---|
| no. of timed visits .. | 90 | 3 | 26 | 25 | 22 |
| shortest period .. | 8 | 20 | 2 | 4 | 5 |
| longest period .. | 917 | 34 | 63 | 108 | 140 |
| mean .. .. | 87.13 | 27 | 16.96 | 39.68 | 48.00 |
| s.e. mean .. .. | 14.00 | .. | 2.95 | 4.97 | 9.08 |
| median .. .. | 42 | 27 | 10 | 35 | 38 |
| IQR median % .. | 156 | .. | 186 | 88 | 165 |
| C.O.V. % .. .. | 152.6 | .. | 88.7 | 62.7 | 88.7 |

For *e*1—*e*8, oviposition visits and first visits of the day have been excluded, as they were clearly longer.

longer ones for this activity. The longest absence before bringing mud was by *e*2 and was of 2441 seconds compared with 1863 seconds by *m*1.

Some inspections were made by *m*1, *e*1, *e*2, and *e*5 after the wasp had been prevented from working by a spell of rain which interrupted building and all other visits of both species, though *m*1 once arrived during a slight drizzle and *e*5 once flew into heavy rain after waiting on the construct for an unusually long period and hovering in the verandah before she left. All mud users which we have observed avoid rain, unlike members of the paper-making social species *Polistes olivaceus*, whom we have seen flying into rain so heavy that they were repeatedly buffetted out of course for the best part of a metre until they gave up and returned to the comb. Because of the wasp's avoidance of rain, it is possible that *m*4 made the longest absence recorded even though her work was not continuously

observed. At 12.17 on 21/10/63, when cell VII was ⅔ complete, rain began. She was not seen again until after 13.17 on 27/10 when cell VII was found completed, the mud on the newly made third of the cell being still wet. The morning of the 27/10 was the first time the sky had ceased to be overcast, and rain had been almost continuous since midday on 21/10. Such weather conditions gave her very few opportunities to make a visit and, as the cell was unfinished, these, if made, must have been loadless. The continuously-watched *e*5 also ceased all building activities for almost seven days during similar weather in the last week of October the year before, but intermittently brought prey to cell XII which was open. The 1963 rainy period also interrupted *e*11 in the middle of provisioning cell V. No further prey were added, nor was there any other indication that the wasp had returned to the construct. Therefore, for the long periods when the absences are certainly due to external causes, there is no indication that one species has a better memory than the other.

There were some inspection visits at the end of the day in both species. On some occasions when a parasite had been on the nest, the *esuriens* seemed very agitated and made several long inspection visits, but in these cases the time spent away from the nests were much shorter than for the other kinds of inspections. Because the visits which wasps have made after completing their crépissage have been always loadless, we think these are true inspection visits and are not a result of the wasps forgetfully taking their old path after starting work on a new site, in the way we interpreted the desertion of *m*2.

## Fetching of Mud

*E. esuriens* had four different activities for which she needed mud: (1) building of the cell wall, (2) putting the lid on the cell, (3) daubing, and (4) crépissage. The fact that *e*1, *e*5, and *e*8 could use the same load of mud for both building part of the wall and to daub indicates that any differences in the composition of the mud used for the two activities are not of any importance. *e*2 and *e*5 also sometimes used the same load for making the lid and daubing. In one period of panic daubing, *e*2 used much more water for her work.

Iwata (1953) and Olberg (1959) have described their observations on species of *Eumenes* where the wasps drank water on some journeys, took it to their mud patch, and regurgitated it there. Our observations support theirs. For *e*1, we knew the location of the spot where she collected her mud. She certainly did not always get it from exactly the same spot but roughly from within a rectangle about 1 metre by 50 cm. She preferred to get it from the bed of a herbaceous border. We could not trace where she got water from, but we know that on some journeys

she did not go to her mud patch which was about 5 m. from her nest but went away to the west, probably to the leaking tap of a neighbour's garden which was about 50 m. away.

The other wasp for whom we have information is *e*5. This wasp got her mud from dry caked soil in exposed rough ground about 27 m. south of the nest and her water from a leaking tap about 50 m. to the east of her nest. By the time *e*5 had built 4 cells (i.e. 13/10) her mud patch had narrowed down to a very small area, and after that she always collected from a roughly circular patch about 30×30 mm. and at that time about 4 mm. deep. She collected all further mud from here and, half way through her crépissage on 2/11, her quarry had narrowed to a pit 10 mm. deep but only 20 and 15 mm. in diameter. It had by then been exposed to heavy rain and hence standing water.

The wasps did not, however, need to fetch water on every journey. They could bring water in their crops sufficient usually for two loads but on occasions even for 3 loads. However we do not know where the wasps went on each of their absences. Fig. 9 shows the distributions of times spent by the wasps in bringing mud for different activities. As one would expect, it takes a wasp a longer time on the average to fetch water and mud than it takes her to fetch mud alone. This is reflected in the bimodalities in several graphs e.g. those for crépissage by *e*5 and cell building for *e*8. The time spent away should therefore indicate whether a wasp went on a ' water+mud ' journey or a ' mud ' journey. But, unfortunately, the ' noise ' is so much that there is considerable overlap and these two types of journeys cannot be sorted out by the time spent on them. The unexpectedly long intervals, some of which have been excluded from the graphs, are probably journeys on which she was either disturbed or on which she fed. Table 14, however, gives the distributions of times spent

TABLE 14

COMPARISON OF TIMES SPENT ON FETCHING MUD ONLY WITH THOSE SPENT ON FETCHING WATER AND MUD

| Object of journey | No. of journeys timed | Range (in secs.) | mean | variance |
|---|---|---|---|---|
| Fetching mud only | 30 | 50–121 | 73·20 ± 3·37 | 634·2 |
| Fetching water+mud | 6 | 100–168 | 144·17 ±10·28 | 340·9 |

for those journeys throughout her construction when we actually saw *e*5 going straight to mud or straight to water. (On some occasions when there had been rain *e*5 did not go to her usual supply of water at all but flew around a herbaceous border. We never actually saw her collecting water accumulated on the leaves of the plants, but suspect that she did).

Concerning *S. madraspatanum*, *m*2 only brought 9 loads and she took considerably longer to fetch them (mean time away, $225 \pm 91$ seconds; range, 116-402 seconds) than either *m*1 or the various *esuriens*. When *m*1 fetched mud, she not only made a choice of several directions when she departed, as did the *esuriens* wasps, but unlike them, she could also *return from one of several directions*. Nevertheless her times away were remarkably constant. When these were classified into the use made of the mud some small but significant differences were found between the times taken to bring mud for different functions. About 10 seconds longer (or 25-30% of the time away) was taken to fetch mud used for the finer work. We previously interpreted these figures as revealing that *m*1 may either have worked the mud for some purposes longer while collecting it or may have chosen some mud more carefully i.e. have had different collecting sites for different purposes. We watched *m*4 collecting her mud to build cell walls. It was scraped with the mandibles, rolled with the front tarsi, and carried in the mandibles. The wasp buzzed during this work as she did while building. Her source was about 38 m. from her nest in a small hollow eroded by the drain from an outdoor bath tap. The soil was slightly soapy but not smelly. She had a stereotyped route of about 40 m. going round the house, and we never saw her either collect water or make any detour suggesting that she did so. Her collecting spots were all within 1 cm. of one another and, for example, during the building of one cell, her left hind tarsus was on one particular stone during all collecting we watched. During another period she was delayed by a column of ants crossing her minute quarry. She collected from an adjacent place which she took time to select, but after carrying away several loads she started dropping them without leaving and, after attempting to collect as near as possible to her own site, she finally returned to it when the ants left. She had a stereotyped landing and walked 2 cm. to her quarry. We could see no difference in location or texture between the mud she used for walls and the mud she used for daubs, and thus consider our second hypothesis about *m*1 inapplicable at least to *m*4, who resembled *e*5 in having one quarry for all purposes.

We have thus failed to confirm Iwata (1942) that *madraspatanum* carries water to its mud patch to damp the mud[1]. On the contrary, we have seen *m*4 collected mud at a permanently damp place, and, as we suspected for *m*1, any damping would have been redundant. The collecting site chosen by *m*4 confirms Iwata (1964) that this species choose relatively dirty mud. The frequent observation of cells filled with mouldy spiders in which no wasp offspring can be found is explained by Iwata

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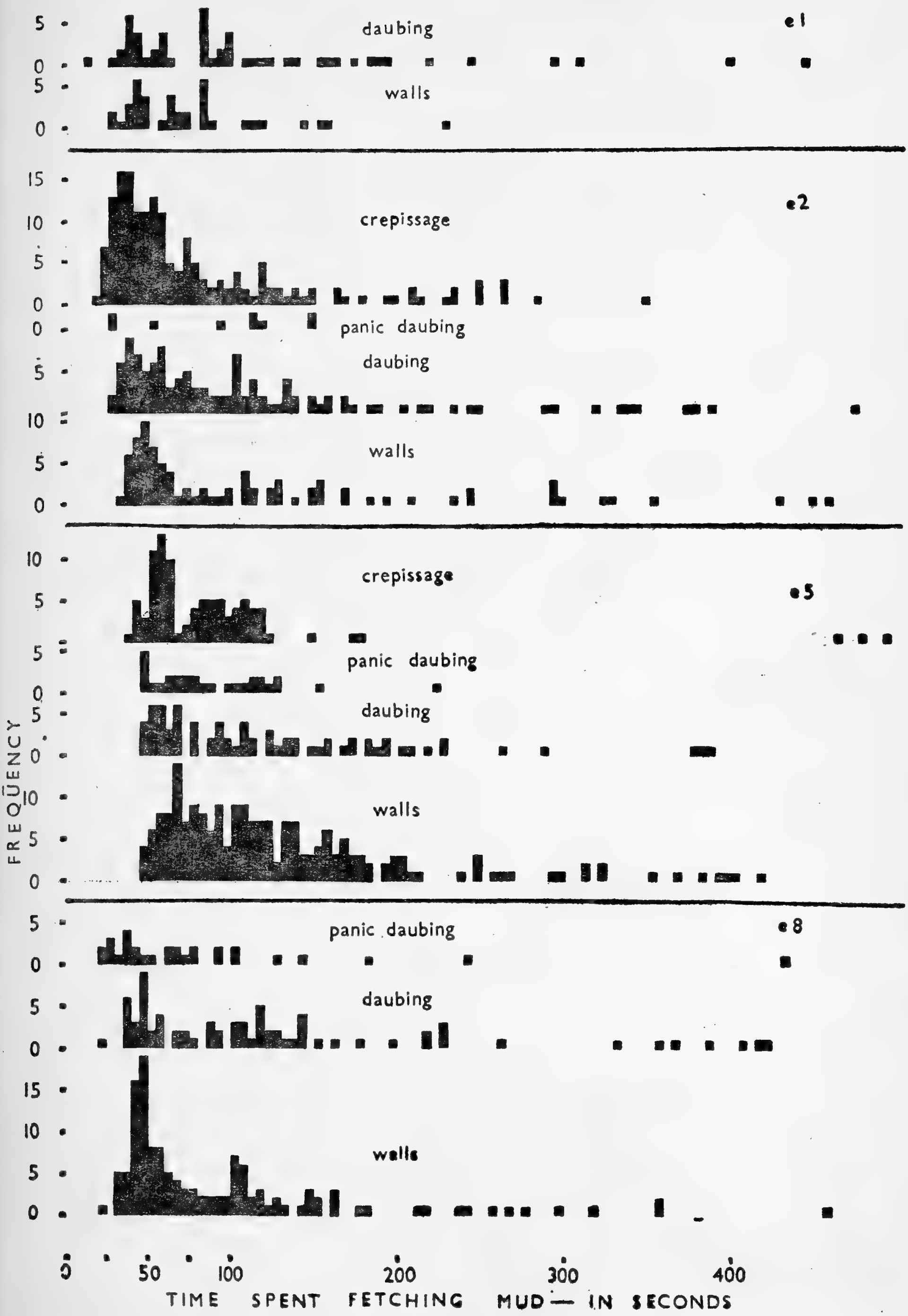
[1] Note added November 1967: We have repeatedly seen the squatter *Chalybion bengalense* Dalb. collect water. This species was included in an extended genus *Sceliphron* by Bingham (1897) and Kohl (1918).



e1
daubing
walls
e2
crepissage
panic daubing
daubing
walls
e5
crepissage
panic daubing
daubing
walls
e8
panic daubing
daubing
walls
FREQUENCY
0
50
100
200
300
400
TIME SPENT FETCHING MUD — IN SECONDS


Fig. 9

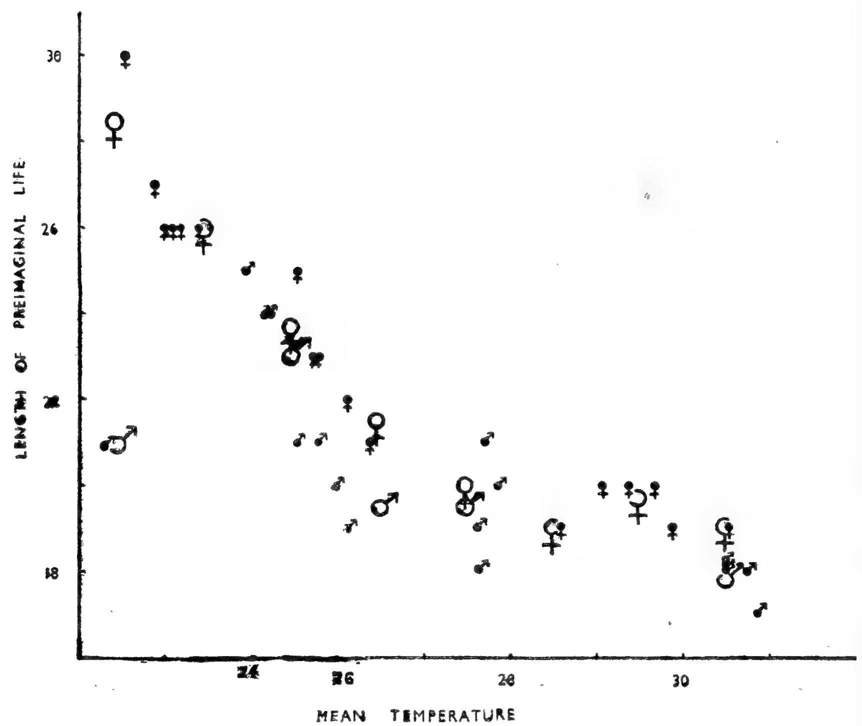

30
26
22
18
LENGTH OF PREIMAGINAL LIFE
24
26
28
30
MEAN TEMPERATURE

Fig. 10

(1964) as due to the organisms present in the mud infecting the spiders so that these become inedible to the wasp larva, who therefore perishes soon after hatching. While confirming the facts, we are nevertheless sceptical of this explanation, perhaps because of our experience as Drosophila workers. Mould does not render a Drosophila culture sterile, it only begins to grow in a culture after this has become sterile for other reasons. Similarly we think that mould would not attack paralyzed but still living spiders ; it would attack only after these had died because a wasp larva had delayed or failed to eat them for some other reason.

## Length of Preimaginal Life, Emergence and Cocoons

The length of the period between oviposition and emergence for *esuriens* is very variable. Assuming that the first egg is the functional one, the length of preimaginal life varies, in our sample of 17 males and 17 females, from 17 to 25 days for males and from 19 to 30 days for females. This variation is largely due to variation in temperature during preimaginal life. Fig. 10 shows the relation between length of preimaginal life and the mean temperature during it. (This is the mean of all daily maximum and minimum temperatures during the relevant period). The solid ♂ and ♀ signs represent individual wasps, while the larger open signs represent mean periods for a given temperature range (Table 15). Even such small samples show that development is speeded

Table 15

Relationship of Length of Pre-imaginal Life to Temperature

| Mean Temperature (°C) | Males | | Females | |
|---|---|---|---|---|
| | Number | Mean length of pre-imaginal life | Number | Mean length of pre-imaginal life |
| 23- | 1 | 21·0 | 2 | 28·5 |
| 24- | | | 4 | 26·0 |
| 25- | 5 | 23·0 | 3 | 23·7 |
| 26- | 2 | 19·5 | 2 | 21·5 |
| 27- | 4 | 19·5 | 1 | 20·0 |
| 28- | .. | | 1 | 19·0 |
| 29- | .. | | 3 | 19·7 |
| 30- | 5 | 17·8 | 1 | 19·0 |
| | 17 | | 17 | |

up with increase in temperature. (The exceptional ♂ on the extreme left of the graph is the small *e*6 II who emerged from a cell sealed only 1

hour after oviposition). It is also clear that females take a longer time than males to develop, and that this difference, where data are available, varies from 0·5 to 1·2 days (excluding the exceptional male *e*6 II). The only comparable data we have on the length of preimaginal life for *madraspatanum* are those for *m*1, for all the imagines produced by *m*4 and *m*5, except perhaps one, had entered diapause in the larval stage. The variation between individuals was much less, the period being 20 days for males and 20-21 days for female (mean 20·35 days). More data must be awaited before a comparison can be made between the two species.

Wasps that have emerged from their pupae in glass tubes are fully coloured but lie passively in a curled up position for well over 36 hours. The bellies of *madraspatanum* are distended with the white pellets of excreta which can be seen through the intersegmental membranes. This confirms Roubaud (1916) that wasps remain as imagines inside their cells for several days. Certainly they do not emerge until they can walk and fly normally. The typical folding of the vespoid wing takes place within two minutes after emergence from the cell.

The imagines of *esuriens* emerged from a hole gnawed in the side of the pot usually facing the source of maximum light. The lids fell off completely and were unexpectedly thin. The lids of *madraspatanum* were even thinner, which was surprising as these were chewed through the convex lid and lid daubing with which the mother had originally sealed the cell. The hole opened had a smaller diameter than the original mouth of the cell, and often the lid was not pushed off by the emerging wasp, but fell back into position lying parallel to the surface of the block and again occluding the hole.

The internal debris in the cells reveals very different larval and pupal organisations. Both species are typical of their taxonomic groups. The inner walls of *esuriens* cells were very faintly silvered as though by snail tracks. This was the only vestige of a cocoon. The larval faeces were deposited as a large yellow or red clayey patch which was adsorbed by the mud of the cell wall. The colour almost certainly depended upon the food. When animals were reared in glass tubes the extrusion of this coincided with the larvae ceasing to be green or yellowish brown, transparent and glassy, and becoming butter-coloured and opaque. Several larvae seemed to drown themselves in their excreta unless some fragment of cell wall or other absorbent substance were present to soak up the liquid. Like other members of their genus (Kohl 1918, Shafer 1949), *madraspatanum* wasps made cylindrical cocoons which, though of silk, had the russet colour and lac-like consistency of a cuticular puparium. The larval excreta formed dense black masses in the proctodeal ends of the cocoons which were sculptured to receive it and thus formed what has previously been called faecal baskets. There is also a butter-coloured

opaque stage after the cessation of feeding and this excretion in *madraspatanum,* and it is in this stage that diapause occurs.

We saw no meconium produced after pupal life in a nest of *esuriens.* It is probable that they void this after flying from the nest as do the social *Polistes.* Shafer (1949) has discussed the development and composition of the little spindle-shaped white pellets of excreta with which *Sceliphron* wasps are full when they emerge from their pupal skin and which they slowly void, both before and after leaving the cell.

## Sex ratio and birth order

Table 16 summarises the emergences we have observed. As would be expected from our descriptions of the wasps' behaviour, a large number of cells were parasitized but, as previously explained, the data given in Table 16 were *not* collected to give any estimate of the frequency of this in this region. There were other causes of death in undisturbed cells which are not easy to explain, and some larval and pupal deaths were certainly due to the abnormal conditions provided by a glass tube.

The individuals of *S. madraspatanum* were sexed by examining their genitalia and/or their antennae. The individuals of *E. esuriens* were sexed by the presence of a hook-like thirteenth segment on each of antenna of the males. Bingham (1897) listed several pigment differences between males and females in this species. We agree with him that the mid and hind tarsi of males are black, and of females russet. We also note, which he does not, that the antennae of males have a dark band at their most swollen point. The male 5 II whom we only saw for 13 minutes on the nest was sexed on these pigmentary characters only. Bingham also stated that females do not possess two black spots present on the ventral surface of the second abdominal segment of males. About half of our females scored are noted as having these spots, which are however fainter, smaller, and more diffuse than any seen on males.

The sex ratios observed in these samples are exactly 1 in each species. This is surprising, as the order in which eggs are laid is far from random. Jayakar (1963) reported a condition which he called ' protarrhenotoky ', namely that during the life of a single female, she lays *all* her male eggs before *all* her female eggs. The data which were available at the time of that publication were those from *e*1 to *e*6 and *m*1. As can be seen from the data now available, at least in *esuriens*, this rule is not invariably followed. In nests *e*8 and *e*23, there were exceptions to this rule ; in the former, 1 male egg having been laid after 4 male and 1 female eggs, and in the latter, 2 male eggs having been laid after 3 female eggs. In *madr aspatanum* so far, we do not have any exception to the rule.

TABLE 16

CELL CONTENTS

| Cell No. | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | XIII | sex ratio ♂ | ♀ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nest | | | | | | | | | | | | | | | |
| *e*1 | C | C | C | | | | | | | | | | | | 5 |
| *e*2 | ♀ | ♀ | ♀ | ♀ | ♀ | | | | | | | | | | |
| *e*3 | u | | | | | | | | | | | | | | 5 |
| *e*4 | (♀ | ♀ | ♀ | ♀ | ♀ | C | C | C) | u | | | | | 5 | 7 |
| *e*5 | ♂† | ♂ | ♂ | ♂ | ♂ | c | ♀ | ♀ | ♀ | ♀ | ♀ | ♀ | ♀pc | 2 | |
| *e*6 | ♂† | ♂ | | | | | | | | | | | | 1 | |
| *e*7 | ♂ | | | | | | | | | | | | | 5 | 1 |
| *e*8 | ♂ | ♂ | ♂ | ♂ | [S | S | S | S] | ♀ | ♂ | u | | | 1 | |
| *e*9 | ♂u | | | | | | | | | | | | | 1 | |
| *e*10 | ♂ | | | | | | | | | | | | | 4 | |
| *e*11 | ♂ | ♂ | ♂ | ♂ | u | | | | | | | | | | |
| *e*12 | d | u | | | | | | | | | | | | 2 | |
| *e*13 | e | ♂ | [S | S] | ♂ | p | d | | | | | | | 1 | 2 |
| *e*14 | ♂ | d | ♀ | C | ♀ | C | C | | | | | | | | |
| *e*15 | (C | C | C | C) | | | | | | | | | | | |
| *e*16 | pu | | | | | | | | | | | | | 1 | |
| *e*17 | ♂ | u | | | | | | | | | | | | | |
| *e*18 | p | C | C | | | | | | | | | | | | |
| *e*19 | ? | | | | | | | | | | | | | | |
| *e*20 | C | C | ul | | | | | | | | | | | | |
| *e*21 | C | u | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *e22* | e | ♀ | ♀p | ♀p | C | C | ♀ | | | | | | 4 |
| *e23* | e | e | ♀ | ♀ | ♀ | ♂ | ♂ | ♀ | u | | | 2 | 4 |
| *e24* | ♂ | C | C | | | | | | | | | 1 | |
| *e25* | ♂p | e | C | ♂ | C | C | C | C | C | u | | 2 | |
| | | | | | | | | | | | Total | 28 | 28 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *m1* | ♂† | ♂ | ♂ | ♂ | ♀p | ♀ | ♀ | ♀ | ♀ | ul | | 4 | 5 |
| *m3* | d | d | S | S | S | d | S | d | S | | | | |
| *m4* | ♂† | ü | ♂† | u | u | ♂† | p | u | ul | | | 3 | |
| *m5* | ♂ | ♂p | ♂ | ♀ | ♀p | ♀ | ♀ | ♀ | u | | | 3 | 5 |
| | | | | | | | | | | | Total | 10 | 10 |

*Key :*

| | |
|---|---|
| u | cell left unsealed |
| C | one chrysid wasp |
| S | several sarcophagine flies |
| c | several chalcid wasps |
| † | died before emergence or otherwise imperfect imago |
| p | died as pupa |
| l | died as larva |
| d | debris—not noted for open cells |
| e | escaped |
| ? | unknown parasite |
| ( ) | order of cell construction unknown |
| [ ] | cells now continuous because holes had been bored by parasites in the intervening walls. |

TABLE 16

CELL CONTENTS

| Cell No. | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | XIII | sex ratio ♂ | ♀ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nest | | | | | | | | | | | | | | | |
| *e*1 | C | C | C | | | | | | | | | | | | |
| *e*2 | ♀ | ♀ | ♀ | ♀ | ♀ | | | | | | | | | | 5 |
| *e*3 | u | | | | | | | | | | | | | | |
| *e*4 | (♀ | ♀ | ♀ | ♀ | ♀ | C | C | C) | u | | | | | | 5 |
| *e*5 | ♂† | ♂ | ♂ | ♂ | ♂ | c | ♀ | ♀ | ♀ | ♀ | ♀ | ♀ | ♀pc | 5 | 7 |
| *e*6 | ♂† | ♂ | | | | | | | | | | | | 2 | |
| *e*7 | ♂ | | | | | | | | | | | | | 1 | |
| *e*8 | ♂ | ♂ | ♂ | ♂ | [S | S | S | S] | ♀ | ♂ | u | | | 5 | 1 |
| *e*9 | ♂u | | | | | | | | | | | | | 1 | |
| *e*10 | ♂ | | | | | | | | | | | | | 1 | |
| *e*11 | ♂ | ♂ | ♂ | ♂ | u | | | | | | | | | 4 | |
| *e*12 | d | u | | | | | | | | | | | | | |
| *e*13 | e | ♂ | [S | S] | ♂ | p | d | | | | | | | 2 | |
| *e*14 | ♂ | d | ♀ | C | ♀ | C | C | | | | | | | 1 | 2 |
| *e*15 | (C | C | C | C) | | | | | | | | | | | |
| *e*16 | pu | | | | | | | | | | | | | | |
| *e*17 | ♂ | u | | | | | | | | | | | | 1 | |
| *e*18 | p | C | C | | | | | | | | | | | | |
| *e*19 | ? | | | | | | | | | | | | | | |
| *e*20 | C | C | ul | | | | | | | | | | | | |
| *e*21 | C | u | | | | | | | | | | | | | |
| *e*22 | e | ♀ | ♀p | ♀p | C | C | ♀ | | | | | | | | 4 |
| *e*23 | e | e | ♀ | ♀ | ♀ | ♂ | ♂ | ♀ | u | | | | | 2 | 4 |
| *e*24 | ♂ | C | C | | | | | | | | | | | 1 | |
| *e*25 | ♂p | e | C | ♂ | C | C | C | C | C | u | | | | 2 | |
| | | | | | | | | | | | | | Total | 28 | 28 |
| *m*1 | ♂† | ♂ | ♂ | ♂ | ♀p | ♀ | ♀ | ♀ | ♀ | ul | | | | 4 | 5 |
| *m*3 | d | d | S | S | S | d | S | d | S | | | | | | |
| *m*4 | ♂† | ü | ♂† | u | u | ♂† | p | u | ul | | | | | 3 | |
| *m*5 | ♂ | ♂p | ♂ | ♀ | ♀p | ♀ | ♀ | ♀ | u | | | | | 3 | 5 |
| | | | | | | | | | | | | | Total | 10 | 10 |

*Key :*

| | |
|---|---|
| u | cell left unsealed |
| C | one chrysid wasp |
| S | several sarcophagine flies |
| c | several chalcid wasps |
| † | died before emergence or otherwise imperfect imago |
| p | died as pupa |
| l | died as larva |
| d | debris—not noted for open cells |
| e | escaped |
| ? | unknown parasite |
| ( ) | order of cell construction unknown |
| [ ] | cells now continuous because holes had been bored by parasites in the intervening walls. |

Arguing from all the *madraspatanum* data where offspring could be sexed, as Jayakar (1963) did for the *esuriens* data, we now compute the probability that if 10 male eggs and 10 female eggs are laid at random in nests of 9, 3 and 8 cells, the rule of all male before all female will not be broken. This probability is $\frac{34}{184756}$ or 1 in 5434.

For *esuriens*, such a test becomes impracticable. The tendency to 'protarrhenotoky' however, is still clearly evident. The data show several peculiarities which are due to this tendency. One is the large number of unisexual broods. Classifying the nests by the number of sexed offspring we have :

| No. of sexed offspring | No. of nests | Sexes of sexed offspring |
|---|---|---|
| 1 | 5 | all ♂♂ |
| 2 | 3 | all ♂♂ |
| 3 | 1 | ♂♀♀ |
| 4 | 2 | ♂♂♂♂ ; ♀♀♀♀ |
| 5 | 2 | all ♀♀ |
| 6 | 2 | ♂♂♂♂♀♂ ; ♀♀♀♂♂♀ |
| 12 | 1 | ♂♂♂♂♂♀♀♀♀♀♀♀ |

All three nests with 2 sexed individuals, both those with 4 individuals, and both with 5 individuals are unisexual. The probabilities of these results are $\frac{1}{8}$, $\frac{1}{64}$, and $\frac{1}{256}$ respectively.

As the hymenopteran sex determining mechanism does not automatically produce a primary sex ratio of 1 at conception, the observation of such a sex ratio at emergence is surprising for at least two reasons. Firstly, all recessive lethal allels, immediately they arise by mutation, must kill all haploid (i.e. male) embryos into which they segregate. Secondly, one would expect the females to be more exposed to predation than males during both their frequent loaded flights over standardised paths, and their preoccupied pauses working on the two small areas of the quarry and the nest. This would be expected to have produced a selection pressure in solitary wasps with highly evolved maternal behaviour patterns which would have resulted in an excess of females in fertilized eggs such as is observed in even the most primitive social species in which the worker caste is not discretely specialized. That such an excess is not observed or, more correctly, that equality itself has been evolved, suggests that some premises should be re-examined (See Jayakar & Spurway 1966 a & b). Dutt (1913) reported that *madraspatanum* has not been discovered in the gut contents of any predator. Both species would be considered aposematic, but no more so than many social species which are known to be predated. Is there a com-

pensatory selection on males? The evolutionary consequences of 'protarrhenotoky' have been briefly discussed by Jayakar (1963).

## Season and Diapause

Table 1 and its footnote list all animals seen associated with a construct in our locality. The few isolated individuals we have seen do not extend the seasons of these species, determined either by when they were seen working or when they emerged in our collection.

There are unaccountable disappearances of both species e.g. the absence in 1964 of *madraspatanum* which was seen that year in both the more urban Calcutta locality, and on the as yet completely undeveloped river bank at Tikerpara, Dhenkanal. However, it seems that *esuriens* is not active during December and January and *madraspatanum* for a shorter period i.e. these species disappear for a 'winter' like their relatives in temperate climates. However we have only discovered diapausing individuals in the latter species.

Table 17 gives the dates of pupation and emergence (from pupae, not cells) of the offspring of *m*4 and *m*5. The nests were dissected on 4/11 and 3/1 respectively when it was thought that all the inmates would

Table 17

Particulars re. Offspring of *S. madraspatanam* Wasps, *m*4 and *m*5

| | laid | defaeca-ted | died | pupated | died | emerged | sex |
|---|---|---|---|---|---|---|---|
| *m*4 I | on or before 18/10 | — | | 26/2 | | 6/3 | ♂ |
| II | 18/10 | | 5/3 | | | | |
| III | 18/10 | | | 25/2 | | 6/3 | ♂ |
| IV | 19/10 | | 5/3 | | | | |
| V | 19/10 | | 17/12 | | | | |
| VI | 20/10 | | | 25/2 | | 6/3 | ♂ |
| VII | 27/10 | 5/11 | | 28/2 | 5/3 | | |
| VIII | 28/10 | 6/11 | 12/11 | | | | |
| IX | 30/10 | 7/11 | 21/12 | | | | |
| *m*5 I | 10/12 | | | 10/3 | | 19/3 | ♂ |
| II | 11/12 | | | 2/3 | 12/3 | | ♂ |
| III | 11/12 | | | <3/1 | | 16/1 | ♂ |
| IV | 12/12 | | | 28/2 | | 11/3 | ♀ |
| V | 14/12 | | | 4/3 | 12/3 | | ♀ |
| VI | on or before 15/12 | | | 28/1 | | 10/2 | ♀ |
| VII | before 17/12 | | | 2/3 | | 11/3 | ♀ |
| VIII | ,, | | | 28/2 | | 10/3 | ♀ |

The date of death is given in the space between the two relevant stages.

have at least ceased feeding and perhaps pupated. Only one, *m*5 II had pupated by 3/1 and this was not the earliest laid. He emerged on 16/1 after a preimaginal life of 36 days, compared with the 20 days recorded for the offspring of *m*1 in July. Therefore it is likely that this individual is to be classified with his sibs as undergoing diapause.

There seems little doubt that all survivors of these two families laid late in the year underwent a diapause. This, as is usual in the group, was undergoing at the end of the last larval instar after feeding had ceased and defaecation had been performed.

It is curious that diapausing larvae should have started pupating before January 3. The range is over 67 days (<3/1-10/3) with a peak involving both families between 25/2 and 4/3. Jayakar & Spurway (1965a) have recorded similar data for *Chalybion bengalense* (Sphecoidea) and *Antodynerus flavescens* var. (Vespoidea) which show that both these species pupate after a diapause which extends well into the summer (May to July). Further observations show that *Chalybion bengalense* comes out of diapause in two bursts, a small one in January and a larger in May to July. There may, of course, be a corresponding second burst in the summer for *madraspatanum*, which we have not yet observed.

Despite the larger samples, we have *no* evidence for diapause in *esuriens*. Rouband (1916) takes for granted that some *Eumenes* species migrate during a dry season to regions with constant water. We may be accumulating evidence that *esuriens* migrates, perhaps southwards, during the coldest months of the year. An alternative suggestion is that the population becomes so much smaller that we have not yet recorded a specimen during this period, perhaps simply because the animals work less rapidly at the lower temperatures. Finally, fertilized females may hibernate as do females of the social wasps in temperate climates, and as *Polistes olivaceus* does even as far south as Calcutta.

## Comparison between Individuals and Species

Table 18 ranks the various working speeds of the four *esuriens* watched in detail using the data presented in previous tables. From this table, *e*2 appeared to perform most jobs more rapidly than the others and *e*5 more slowly. This is confirmed by their mud fetching times graphed in Fig. 9. *e*5 worked at the coolest period of the year but the temperatures for *e*2 were only slightly higher, and lower than those for *e*1 and *e*8. Therefore *e*2 seemed more energetic than *e*5. She also used more loads during both her periods of *inphase* daubing and during her crépissage (Table 11), though this covered a surface of comparable area in both constructs. She perhaps also used more loads in cell construction (Table 2).

From the dates and location of the nests it is possible that *e*2 and *e*5 were the same wasp. The differences in their speed of work do not con-

TABLE 18

COMPARISON OF WORK SPEED IN *esuriens* INDIVIDUALS

| | data from table | *e*1 | *e*2 | *e*5 | *e*8 |
|---|---|---|---|---|---|
| *On* walls | 3 | 1 / *2* | 2 / *1* | 4 / *4* | 3 / *3* |
| *On* lid | 10 | 1 / *1* | 3 / *3* | 4 / *4* | 2 / *2* |
| *On* daub | 11 | 4 / *3* | 1 / *1* | 2 / *2* | 3 / *4* |
| *On* panic daub | 11 | + / + | 1 / *1* | 2 / *2* | 3 / *3* |
| *On* crépissage | 11 | + / + | 1 / *1* | 2 / *2* | + / + |
| *Away* prey | 6 | 3 / *3* | 2 / *2* | 4 / *4* | 1 / *1* |
| *On* prey | 7 | 2 / *2* | 4 / *4* | 3 / *3* | 1 / *1* |
| *Away* inspection | 12 | 2 / *2* | 1 / *1* | 3 / *3* | 4 / *4* |
| *On* inspection | 13 | 2 / *4* | 1 / *1* | 3 / *2* | 4 / *3* |

1 the quickest work on the evidence provided by means.
*1* on the evidence provided by *medians*.

tradict this possibility, as we have seen different work tempos in the same individual of *E. e. conoideus* when working on different constructs. Also, the observation that *e*2 and *e*5 seemed to have different water and mud sources is again not evidence for their separate identity as we have seen an *E. p. pyriformis* change her water source when beginning a second group of cells in a new place.

The daubing of the previous construct by *e*1 before provisioning the naked open cell has not yet been noticed in any other *Eumenes* wasp.

As it was only observed twice, it may not reveal a consistent idiosyncrasy of behaviour.

If these four wasps and *m*1 are typical of their species, the vespoid seems more efficient than the sphecoid. For the analogous chores, pot building, provisioning, and sealing, *esuriens* wasps achieve a comparable result with fewer loads than a *madraspatanum*. This economy, like their capacity to return with the appropriate loads after longer absences, is harmonious with the morphological conclusion that the vespoids are a more advanced group than the sphecoids.

## Discussion

For two centuries the behaviour of the Hymenoptera has been studied—and studied by some of the greatest biologists of whom we have historical record. These insects were often discussed as providing the most typical examples of instinctive behaviour. And by the criteria of species specificity and of performance without any previous apprenticeship (which are not two criteria but one), construction, predation, and other rearing activities of our wasps can be judged to be instinctive. We know of three systematic attempts to analyse the behaviour of members of the Aculeata influenced by the concepts of instinct due to Lorenz and Tinbergen (L-T), those of Deleurance (*e.g.* 1957), Tsuneki (*e.g.* 1958), and Evans (*e.g.* 1966).

These studies, and our own observations, completely vindicate Lorenz's emphasis that an instinct is best defined by motor patterns. They also vindicate his division of these motor patterns into *Erbkoordinationen* (or fixed action patterns) and taxis components. Because wasps make material artifacts, we are able to see that taxis components are typical of the homeostatic capacities that are characteristic of living creatures. The taxis components are necessary for a wasp to be able to build a species-specific nest on an individual location with special, theoretically unique, features by means of movements which are at least species-specific and often characteristic of much larger taxa.

We have described elsewhere (Jayakar & Spurway 1965b) the failure of two individuals of *E. emarginatus conoideus* to oviposit on finishing their cells and their different subsequent behaviour. One (*c*3) continued normally. The other (*c*12) seemed unable to stop building and so constructed a pathological nest. Wasp *c*12 thus behaved as did Tsuneki's *Bembix niponica* and showed that the reproductive sequence is divided into sub-sequences of activities each of which is ended by a consummatory activity without which the next sub-sequence cannot be initiated, and after which, Tsuneki showed experimentally in his sphecoids, they cannot return to an earlier sub-sequence. This pattern of nervous organisation is characteristic of vertebrate instincts as L-T describe them. However

the behaviour of *c*3 reveals that in wasps there is some variation in this organisation which may make possible an escape from its rigour.

If the motor pattern of the wasps' behaviour is harmonious with the L-T analysis, and the neural organisation sometimes so, the sensory aspects seem to be much less so. The fact that we have not performed experiments on our wasps would not have prevented us from gathering information on these matters if the information had been in the form in which it is revealed in vertebrate behaviour. We have been using a technique which L and T have themselves emphasised as being very fertile—observing the behaviour of animals surrounded by, and utilizing human artifacts. We have observed, as do all observers, the inevitable mistakes and miscarriages that such animals make, and we have observed their reaction to the inevitable interferences or frustrations which such animals invariably encounter. The technical vocabulary of L-T does immediately leap to the mind while watching mistakes being made, and frustrations being reacted to, by vertebrates. But this vocabulary does not leap to the mind while watching wasps which, as previous observers have noted, are much more succinctly described in human terms. A wasp making a mistake resembles much more a man entering the wrong house or, having forgotten where he put down his book, than a fledgling sparrow trying to perch on a horizontal high-light on a motor car or, among insects, a butterfly alighting on a coloured fabric while flying between flowers.

No reaction, usual or unusual, has suggested to us any hypothesis about the *sign stimuli* relevant to these wasps. Judging from the animals' movements, among the most important of these for building are those perceived tactilely by the antennae. The scanning movements differ in the two species. It is always difficult to recognise stimuli to senses which the observer does not share but, for example in work on the courtship of many insects, sign stimuli have been recognised, or at least models have been presented that provided sign stimuli. We, on the other hand, have seen neither a mistake in the putting down of a load, nor a pause that suggested that a sign stimulus was attended, but had not yet arrived. The ceaseless antennal probing can be described as *appetitive behaviour*, but the form of this seeking gives us no reason to classify the stimuli which it collects into two classes, of which one precipitates an instinctive action, and another which gives immediate information about the present state of the construct, and is relevant to the special features of the work. A wasp may put down a load on an obvious imperfection, or she may put it down completely isolated only to be joined up many loads later. We have not been able to recognise any evidence of an *innate releasing mechanism* common to these acts.

The much more thorough experimental analyses of Tsuneki confirm us in this matter. In his work on *Bembix niponica*, he is able to describe

the context which, on L-T instinct theory, must present the sign stimuli (or releasing factors) evoking the next sequence of movements. However, these contexts are only described in terms of their biological function e.g, ' burrowing ground', ' paralysed prey ', ' operated prey', ' stored prey.' This is unsatisfactory. A sign stimulus can be presented and be effective quite *independently* of its normal context, *and it is identified by this experimental technique.* In William James's metaphor, we have never seen a wasp reacting to a label independent of its usual parcel.

However, *c*12 also showed a classic characteristic of instinctive reactions to sensory stimuli. As her nest became deformed she made a bad job worse because she reacted to certain features *only* when the stimuli these produced were relevant in the *normal* sequence. In an unusual context, objects, though undoubtedly perceived, were unable to stimulate a modification of behaviour, i.e., they presented no sign stimuli, as the wasp possessed no appropriate innate releasing mechanism to be stimulated. There is every reason to believe that *esuriens* and *madraspatanum* would show similar nervous organisation.

We have seen two members of *E. emarginatus conoideus* (Jayakar & Spurway, 1965b) and an individual of *Polistes olivaceus* put down preliminary loads before constructing their first cells as has been described for *e*11 and *e*22. Therefore abortive building is a typical activity of vespoids at least. Can it be regarded as parallel to the *intention movements* with which, for example, birds make abortive nest building attempts? This identification is fertile, but cannot, we think, be made without qualification. Does it justify the induction that nesting is controlled by a ' reproductive drive ' (potentially describable in chemico-physiological terms) which gradually develops and/or accumulates in the individual animal as any other physical product may gradually increase; and when present in quantities inadequate to produce functionally efficient activities, produces small dissociated scraps of activity? The actual physical movements with which wasps make the abortive brackets and pedicels are in every way normal in form, intensity, and therefore, (at least temporarily) efficiency. They are associated with long periods of feeling which we have recognised as appetitive behaviour. They are not therefore like the intention movements of vertebrates, which are slight, languid, short, and have only traces of their typical form. The abortive behaviour of wasps resembles much more the early sketches of books or pictures on which some artists spend much thought, excitement, and effort before they determine on the final form. The tendency to make false starts may be as much a common idiosyncracy among wasps as it is among men. If the two kinds of behaviour, i.e. the vertebrate languor and half-heartedness in performance and the wasp's lack of persistence with a particular construct (not lack of persistence with the performance of the activity) are interpreted as evidence for a physiological state in the

creatures concerned sufficiently alike for the same technical term (e.g. 'low motivation' or 'weak drive') to be applied, the differences between the two kinds of activity equally reveal that there are considerable differences between the nervous organisations of mechanical work which the drives activate.

The only obviously bad workmanship we have seen in these two species was the desertion of a partially built cell by *e*4 and *m*3. *e*21 had presumably put down the two orientated brackets 7 cm. from her first definitive cell. This may be a third example or may be more comparable to the abortive brackets just discussed. Roubaud (1916) discussed in detail many inefficient practices which he has observed in the African *Eumenes tinctor*. In discussing these, he approaches very closely a Tinbergian point of view, attributing them to various responses to the difficulty in finding provisions during the season in which they occur. Roubaud's wasps, in addition to laying extra eggs which we have previously discussed, sealed these extra eggs in cells without provisions. This he interprets as due to their inability to delay too long the performance of one part of the normal sequence because environmental conditions have prevented a previous phase from being completed or consummated. Roubaud has also seen wasps who went into periods of continuous cell building and plastering which he interprets as neurotic behaviours consequent on the frustrations of failing to find prey for provisions. In this he approaches very closely the Tinbergian idea of *displacement activity*.

The delays which we observed in our animals were caused by rain. As we have emphasised, these produced no sign of disturbance in the normal and functionally efficient sequence of activities. The wasps, on return, examined their construct and continued with the efficient task. Some delay in beginning again, and consequent repeated inspections, was sometimes observed, and may be attributed to waiting for the relevant drive to develop. If we accept this hypothesis, we are again saying that 'drives' in wasps are integrated with the other nervous functions in a different way from that in which they are hypothesised to be integrated in non-human vertebrates. On any hypothesis, wasps seem much less slaves of their drives—they almost invariably do what the external occasion demands, not what their internal physiological condition demands.

Both *e*2 and *e*8 did some daubing out of their usual sequence of activities. On one occasion *e*8 carried out this daubing in the middle of building a cell. On all other occasions, it was hunting that was interrupted; *e*1 did daub after building a cell but she did this for both cells that she was observed building. Although this 'out-of-sequence' daubing did not have any function obvious to us, it cannot be labelled as an inefficient activity.

We have seen no behaviour which we would describe as *displacement activities*, though we watched wasps repeatedly in situations of frustration and conflict where these are very common in vertebrates. We have seen on several occasions a wasp showing clearly that she was under a conflict to attack or flee when finding a parasite on her nest; we have seen the perturbation followed by repeated agitated checking of landmarks when a nest site is moved or a landmark altered; we have seen animals struggle for long periods to insert reasonably active prey, and, in the case of *m*1, both fail to do so, and also remove their own prey accidently; we have seen animals drop their loads or leave them half-worked when disturbed; but in all these contexts we have not seen any movement which we could recognise as being characteristic of another activity. *We have never seen a wasp make movements characteristic of an activity when any recognisable part of the consummatory situation was absent.* There is every evidence that a wasp, as a rule, ceases working when she has achieved a consummatory situation, not when she has performed a consummatory act. The only possible exception was *c*12 whose behaviour was not duplicated by *c*3.

In the context in which we were observing, it is not critical that we observed no *vacuum activities*, which are probably most common in captive animals deprived of much of the environment to which they have evolved adaptations.

We then suggest that the anthropomorphic language which entomologists working with the higher hymenoptera use, and defend, reveals that these animals must in their behaviour be seriously compared with *Homo sapiens* and perhaps other mammals, and not with the lower vertebrates and the other insects whose behaviour has contributed so much to instinct theory.

There is no doubt that men are descended from ancestors who were more instinctive than themselves, and traces of human instincts are easy to find. Freud was admittedly influenced by the workers whom the ethological school regard as their precursors. However it is inefficient to describe human behaviour in a vocabulary coined to describe instinctive behaviour—too much both in quantity, and in complexity, is omitted. We suggest that our Hymenoptera show an analogous complication of behaviour, in which the complication has similarly become so great as to form a superstructure not only more conspicuous to the observer, but more important to the performer. Haldane & Spurway (1954) approached this conclusion by stating that in the Hymenoptera there had been an increase in the importance of taxis components relative to *Erbkoordinationen*, comparable to that which McDougal had previously pointed out occurred in the mammals. For example, they suggested that the bees' communicatory dances had evolved from intention movements assuming these to have the form observed in vertebrates, and this

hypothesis has been accepted by Thorpe (1956). Our observation, that the only analogues to intention movements which we have seen performed by our wasps were of an intensity high enough to be functionally efficient, is not incompatible with this hypothesis. Tsuneki (1958) made another approach to our present conclusion : ' Behaviour of *Bembix* exhibited during her brood-rearing activities can all be attributed to the so-called appetitive behaviour in its broadest sense '.

From its systematic context, this evolutionary trend in the Hymenoptera must be entirely independent of that in the primates, (or the mammals). Therefore there is a strong case for attempting to avoid an anthropomorphic vocabulary however much this may be succinct, elegant, and express the tenderness observers feel for members of this group. Since evolution has been accepted as a fact, there has been a tendency to redefine homology in terms of hypothesised common ancestry and to avoid using the *same word* for phenomena where this cannot be presumed, however similar these phenomena may be. This rule is frequently ignored. Nevertheless, though it would be foolish pedantry to refuse to use the term ' head ' for a structure in both the arthropods and vertebrates because their latest common ancestors were acephalic, it may not be comparable pedantry to work out a vocabulary that would not blur the differences expected between systems whose rarity and independent evolution in the animal kingdom are perhaps their most striking features.

It is important that this escape from instinctive behaviour had arisen in both groups before the evolution of social species (in the narrow and most useful sense). Can a comparable evolutionary trend be detected in the Isoptera, or would it have been more conspicuous in their less specialized ancestors ?

It must be emphasised that we have documented only a fraction of the behaviour patterns, even of the imaginal stage of these insects. We know nothing of their sexual, eating, hunting, or sleeping behaviours, or their nesting behaviour independent of human artifacts, or the behaviour of *esuriens* when it disappears from our biotype during the cold weather. All these phases of behaviour are of more general occurrence in the animal kingdom than building and provisioning, and it is probable that the movements and reactions of wasps while performing them may, like the behaviour of humans in the same contexts, be more comparable with the instinctive behaviour of other animals.

## Summary

Twenty-five nests of the vespoid potter wasp *Eumenes campaniformis esuriens* (Fabr.) are described. All were on or in contemporary concrete buildings in Bhubaneswar, Orissa. Twenty-two were found

associated with their builders, and an attempt was made to time, and describe briefly, all visits to four of these nests from discovery to desertion. These totalled 1459.

Site selection, pot building, oviposition, provisioning with insect larvae, sealing, the various subsequent daubings, the stimuli which precipitated desertion, loadless visits, and the fetching of building mud are described. The number and durations of collecting periods, and work periods on the nests are analysed.

The duration of pre-imaginal life, which is temperature sensitive, is discussed as is the unexpected sex ratio of unity. Individual broods were unisexual or with one exception showed an approximation to 'protoarrhenotoky'. No individual has been observed to enter diapause, but the species, like other wasps in this locality, has not yet been observed during December and January.

Five nests of the sphecoid potter *Sceliphron madraspatanum* (Fabr.) are also discussed, including one nest described in detail in an earlier paper (Spurway *et al.* 1964). Throughout, a comparison is made between the two species which ecologically overlap in site selection.

No sign stimulus (or releaser) has yet been recognised for either species, neither have they been observed to perform a displacement activity.

## Acknowledgements

We are grateful to Dr. R. W. Crosskey of Leiden, Dr. H. E. Evans of Harvard, Dr. J. B. S. Haldane of Bhubaneswar, Dr. W. D. Hamilton of London, Dr. K. Iwata of Sasayama, Dr. N. E. Marston of Wyoming University, Dr. E. Mayr of Harvard, Dr. K. Tsuneki of Fukui, Dr. J. Van der Vecht of Leiden, and Dr. S. Zimmerman of Vienna, who have identified animals, given introductions, reprints and the advice and other help without which scientific work is impossible.

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## *ERRATA to part* 1.

p. 312 3rd para line 12 for 11.20 *read* 11.30.

p. 313 2nd para line 16 for 140 *read* 100.

p. 326 Table 5 the sex of wasp 5 II was ♂.

# A Catalogue of the Birds in the Collection of the Bombay Natural History Society—1

## Gaviiformes to Ciconiiformes

BY

HUMAYUN ABDULALI

### INTRODUCTION

The first number of the *Journal of the Bombay Natural History Society* (1886) contained a list of birds of 144 species in the collection of the Society, collected by a Mr. Anderson at Simla and Col. W. B. Thompson in Cashmere. From time to time the *Journal* carried lists and notes on the birds of the various districts and provinces, and such contributions were almost invariably accompanied by specimens, at least of the more interesting forms, to support the identification. Sportsmen all over the country sent in specimens (or parts) of ducks, geese, and swans which they could not identify, or in support of new records from outside the known ranges.

The publication of Stuart Baker's FAUNA OF BRITISH INDIA : BIRDS, Vols. 1-8, 1922-1930, drew attention to the absence of an essential requirement for the determination of subspecies, namely series of specimens from different places of the form under examination. The first attempt to fill in these gaps was the Scientific Survey, sponsored by Mr. A. S. Vernay, of the Eastern Ghats, an area which had been omitted from the Society's extensive Mammal Survey commenced before the First World War. The Ornithological Section of the Vernay Survey, which commenced work in April 1929, obtained fair series of the commoner birds, and the collection was reported upon by Hugh Whistler & N. B. Kinnear in the Society's *Journal*. This report is still an indispensable work of reference for any study of Indian birds, for the authors had access not only to the earlier literature but also to the specimens collected by giants like Jerdon and Hume and they not only published their findings but also discussed the evidence examined by them.

Then followed the ornithological surveys of the various States, namely Hyderabad, Mysore, Travancore and Cochin, etc., most of them by Dr. Sálim Ali.

And, all this time, members throughout the country, many of them officers of the Civil, the Forest, and the Police Services, continued to send occasional specimens for their own information or in support of notes and observations made by them.

The collections obtained by the Surveys were reported upon, mostly by Hugh Whistler, N. B. Kinnear, and C. B. Ticehurst, who between them described several new races and built upon the foundations laid by Stuart Baker. I have no figures, but my association with the Society and its collections, extending over three decades, had left me with the impression that the key specimens were usually retained in England though the numerical bulk was returned to the Society. As the several collections were worked out separately at different times all the specimens were never looked at together. In addition to this, the occasional specimens added from time to time to the collections do not appear to have been critically examined.

When working out my collection from the Andamans, I could not help being struck by the fact that many specimens did not agree with the accounts in current literature. The transfer to the Society's new premises has now made it possible, in spite of distressingly inadequate furniture and equipment, to lay out series of specimens of more than one species and to take a reasonable amount of time over their comparison and study. This therefore is an attempt to list the 22,900 odd specimens in the Bombay collection and to name as many as possible trinomially. This will undoubtedly take a considerable time and, therefore, if any specimen has indicated an extension of the known range of any species or form or necessitated the correction of an earlier record, or where the specimens available have permitted a taxonomic conclusion which differs from that in the SYNOPSIS, I have published my findings separately from time to time.

This instalment of my Catalogue ends with the flamingoes (No. 74 in the SYNOPSIS) and deals with about 435 specimens, up to Register No. 22914 in the Society's collection.

As the number of specimens is expected to increase from time to time and efforts will be made to keep the catalogue up-to-date as far as possible, the highest registered number covered by further instalments will be mentioned in each case.

This work has been and continues to be interesting and many unexpected discoveries have turned up. Twenty-four of the forms mentioned in this instalment are entirely missing from our collection. The paucity of specimens of several forms from many parts of India is patent and I can only hope that these notes will prompt all those, who have the opportunity, to help complete the Society's collection. In many instances we lack specimens of species common in other parts of the world, and I am sure the Society would be glad to consider any ex-

change against species available in India. Our taxonomic studies are far from complete ; the days of random collecting for most districts have gone, but specimens of different species are needed from many areas and the work can only be completed with the help of individuals in different places. The Society's collection with all its gaps is one of the best in the country and is intended to form the base of many taxonomic and other studies in India. In instances where migrant species from the north are of two or more races, it is yet unknown to what extent they occupy the same or different areas in India. Of resident species, it is necessary to have series from different parts of the country and at different seasons to determine if there are any consistent differences between such populations. Where the type locality is also mentioned, specimens from these areas (topotypes) are essential for further study. I hope that members in India will help whenever they can. It may be possible for the Society to give lessons in skinning to those who are willing to help, and also to assist them to obtain such permits as are necessary.

## Explanations

In this Catalogue, the sequence and terminology is generally that used by Ripley in his SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN (1961). Where this differs from subsequent (or even earlier) records and where it is not possible for me to decide which is correct, I have retained the name as in the SYNOPSIS and referred to the differences. The name is preceded by the number in the SYNOPSIS and followed by the type locality in parenthesis, the English name, and the volume number and page of Stuart Baker's FAUNA. The absence of this reference indicates that the species/race is not listed in the SYNOPSIS or the FAUNA, as the case may be. The next line gives the number of specimens, followed by figures showing the break-up by sex. Young and juvenile plumages are difficult to designate exactly, particularly as the correct sequence in many Indian birds is imperfectly known. I have referred to young birds in non-flying plumage (e.g. down), both nidifugous and nidicolous, as chicks (abbreviated : ch.), keeping the term pulli (abbreviated : pull.) for young with feathers insufficiently developed to permit flight. Young in their first flying plumage are referred to as juv. (juvenile) or imm. (immature). If a plumage (in which the bird may breed) intervenes between the first flying plumage and the final dress, the bird in such plumage is referred to as sub-ad. (sub-adult). Where sexual, seasonal, or other differences of plumage exist, an attempt is made to indicate which forms are available, e.g. non-flying young or pulli, juvenile, in nuptial plumage, etc. Heads and necks of geese and swans, which form the basis of several records from India, were not

registered ; this has now been done. Entries relating to species which do not occur in Indian limits, but of which specimens are available, are preceded by the prefix EL (extra-limital). I should mention here that by the term ' Indian limits ' I understand the area covered by the SYNOPSIS, i.e. India and Pakistan, together with Nepal, Sikkim, Bhutan, and Ceylon, and also ' the area known roughly as south-east Tibet, the districts of Charme, Takpo, Kongbo, Pemakö and Pome especially, lying as they do along the upper reaches of valleys and waterways of Bhutan and the hills of northern Assam ', and the Andaman and Nicobar Islands.

Then follows a list of the localities from which the specimens have been obtained ; this will serve to indicate at a glance the paucity of material from large areas. Specimens of species and subspecies known to occur in India, but which have been obtained outside our limits, are included but italicised. Where the examination of the material available has raised any points of interest, these are mentioned. They may serve to indicate lines of further work and clarification by those who have the opportunity. Unless otherwise mentioned or appearing from the context, the measurements are in millimetres, the bill is measured from the feathers on the forehead, and the measurements in brackets are from the FAUNA.

In the text, references to literature are made in the customary manner, except :

*JBNHS* or *Journal*.. *Journal of the Bombay Natural History Society.*

FAUNA .. .. Stuart Baker's FAUNA OF BRITISH INDIA, Birds, Vols. 1-8 (1922-1930).

OLD FAUNA .. The first edition of the FAUNA, Vols. 1-4 (1889-1898), by Blanford & Oates.

BR. HANDBOOK .. HANDBOOK OF BRITISH BIRDS, Vols. 1-5 (1938-1941), by Witherby, Jourdain, Ticehurst, and Tucker.

* IND. HANDBOOK .. HANDBOOK OF THE BIRDS OF INDIA AND PAKISTAN, by Sálim Ali and S. Dillon Ripley.

Vaurie .. .. THE BIRDS OF THE PALEARCTIC FAUNA, Passeriformes (1959) and Non-Passeriformes (1965).

Ripley or SYNOPSIS.. A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN (1961).

Before I proceed with the formal list, I record my appreciation of the help received from the assistants at the Society, particularly V. C. Ambedkar, B. R. Grubh, D. N. Mathew, M. J. Pereira, and P. B.

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* This is yet in the press but it is hoped that it will be possible to refer to it in succeeding instalments.

Shekar, without which my work involving, in addition to mere handling, the measuring of almost every specimen would not have been possible.

Finally, a word of explanation. It is possible that some of my remarks and conclusions are erroneous or out of date. This may be attributed, in part at least, to the absence of several standard works on the ornithology of other parts of the world, as also many of the foreign journals and periodicals. Remedy of the former need would necessitate an appreciable amount of capital investment, but the latter can perhaps be made good, or at least kept up to date, by exchanges against the Society's journal. I trust that this will be done and better facilities will be available to future workers, both in this and in other groups.

1 **Gavia arctica** (Linnaeus) (Russian Turkestan) Blackthroated Diver **6** : 485

1 : ♀ Ambala, Punjab.

This specimen, which constitutes the only record from India, has been named *suschkini* (Sarudny) in both the FAUNA and the SYNOPSIS, ignoring Ticehurst's statement (*JBNHS* **34** : 490) that the specimen does not permit subspecific identification. Vaurie treats *suschkini* as a synonym of the typical race.

2 **Gavia stellata** (Pontoppidan) (Denmark) Redthroated Diver **8** : 703

nil.

3 **Podiceps cristatus cristatus** (Linnaeus) (Sweden) Great Crested Grebe **6** : 477

10 : 5 ♂♂ 5 o ?

6 *Persian Gulf and Mesopotamia* ; 1 *Peking, China* : 1 Gujner, Bikaner 1 Viramgam, Gujarat ; 1 no data.

4 **Podiceps nigricollis nigricollis** Brehm (Germany) Blacknecked Grebe **6** : 480

(=*P. caspicus caspicus* (Hablizl) as per Opinion 406, 1956, *Internat. Comm. Zool. Nomen.* **13** : 121)

5 : 3 ♂♂ 2 o ?

2 *Banderi-Gaz, near Astrabad, Caspian Province* ; 1 *Mesopotamia* ; 1 Bhavnagar ; 1 Poona.

EL **Podiceps ruficollis poggei** (Reichenow) (Province of Chihili, China) Little Grebe

1 : ♀ *Peking, China.*

This can be distinguished from the other races by the almost complete absence of the white patch on the wing-coverts.

EL **Podiceps ruficollis iraquensis** Ticehurst (Ishandarieyeh, Euphrates)

5 : 3 ♂♂ 1 ♀ 1 o ?

5 *Persian Gulf.*

They are all in immature non-breeding plumage and I cannot distinguish them from birds from India either by size or by plumage.

5 **Podiceps ruficollis capensis** Salvadori (Shoa, Africa) **6** : 481

29 : 9 ♂♂ 9 ♀♀ 11 o ?

2 Kalat, Baluchistan ; 1 Manchar, Sind ; 1 Simla ; 2 Bahawalpur ; 1 Gwalior ; 1 Rajputana ; 2 Meerut, U.P. ; 8 Bombay, 2 Nasik, Maharashtra ; 1 Palnis ; 1 Calcutta Market ; 1 Assam ; 2 *Burma* ; 4 no data.

A female from Kalat, Baluchistan, in breeding plumage has the rufous of the neck extending further downwards than in any of the others. This and a male from the same area and another from Sylhet, Assam, have the underparts irregularly marked ashy, separating them from all the others.

6 **Daption capensis** (Linnaeus) (Cape of Good Hope) Cape Pigeon or Cape Petrel **6** : 307

nil.

7 **Procellaria leucomelaena** Temminck (Seas of Japan and Nagasaki Bay) Whitefronted Shearwater **6** : 306

nil.

8 **Procellaria carneipes** (Gould) (Small islands off Cape Leeuwin, West Australia) Pinkfooted Shearwater **6** : 305

nil.

9 **Procellaria pacifica chlorohyncha** (Lesson) (Sharks Bay, Western Australia) Wedgetailed Shearwater **6** : 303

nil.

10 **Procellaria tenuirostris** Temminck (Japan) Slenderbilled Shearwater **6** : 304

nil.

11 **Procellaria lherminieri bailloni** Bonaparte (Mauritius) Audubon's Shearwater

nil.

12 **Procellaria lherminieri persica** Hume (At sea between Guadar and Muscat) Persian Shearwater **6** : 306

2 ♀♀ : 1 Bombay (wing : 202) and 1 Alibag, Kolaba (211), both taken in July.

12a **Bulweria bulwer** (Jardine and Selby) (Madeira) Bulwer's Petrel No specimen.

This species is mentioned for the Maldives in Vaurie (1965, p. 22) and for the Laccadives by Phillips, *Bull. B.O.C.* **79** : 100 (1959).

13 **Bulweria aterrima** (Bonaparte) (Reunion) Mascarene Black Petrel

The first and only specimen from India (*JBNHS* **42** : 193) was not registered and is now not traceable.

13a **Bulweria fallax** Jouanin (Near Socotra, 12° 30″ N, 55°E) Small Black Petrel.

No specimen

Ripley (*JBNHS* **60** : 687) has suggested that this may have been the species recorded as *B. aterrima* (q.v.)

14 **Oceanites oceanicus oceanicus** (Kuhl) (South Georgia) Wilson's Storm Petrel **6** : 300

1 : ♂ Bombay (wing : 145).

15 **Fregetta tropica melanogaster** (Gould) (Southern Indian Ocean) Duskyvented Storm Petrel **6** : 302

nil.

16 **Oceanodroma leucorhoa monorhis** (Swinhoe) (Amoy, China) Leach's Petrel, Forktailed Storm Petrel.

nil.

17 **Phaethon aethereus indicus** Hume (Mekran Coast) Short-tailed Tropic-bird **6** : 291

6 : 3 ♀♀ 3 o ?
5 *Persian Gulf*; 1 Kolaba, Maharashtra.

Three have the middle pair of tail feathers elongated, one in each pair being frayed and the other fresh.

18 **Phaethon rubricauda rubricauda** Boddaert (Mauritius) Redtailed Tropic-bird **6** : 292

nil.

19 **Phaethon lepturus lepturus** Daudin (Mauritius) Longtailed Tropic-bird **6** : 293

nil.

20 **Pelecanus onocrotalus** Linnaeus (Africa, Asia) White or Rosy Pelican **6** : 271

8 : 2 ♂♂ 3 ♀♀ 3 o ?
1 *Mesopotamia* ; 4 Gujarat ; 3 Bihar.

There still appears to be diversity of opinion regarding the relationships of the several pelicans. The SYNOPSIS has no races of this species and treats *crispus* as a race of *philippensis*. In the NEW DICTIONARY OF BIRDS (1964, p. 608), the expression ' White (or Rosy or Spotted-billed) Pelican ' seems to refer to one species.

The present identifications are based on the key in the FAUNA—the feathers of the forehead ending in a point in this species as against an

inwardly curved line in the others. The primary shafts are also all pale coloured as against black in the others.

Their wings measure 612-735 (av. 675) and bills 303-420 (av. 341). While these measurements are more or less in keeping with those recorded earlier, it is curious that the only two birds which are completely brown above, i.e. in immature plumage, have the largest wings, 700 and 735. Their bills are 335 and 420 respectively, both being unsexed.

21 **Pelecanus philippensis philippensis** Gmelin (Manila) Grey or Spottedbilled Pelican **6** : 274

3 : 1 ♂ 2 ♀♀.

1 Vizagapatam ; 1 Madhubani, Darbhanga, Bihar ; 1 no data, collected like the immediately preceding specimen by C. M. Inglis and probably from same area.

In the two females (both September) the ivory-white bills, with the line of irregularly shaped black spots on both sides, are very distinct. In the male (June) the bill is brownish with traces of some parts having peeled off.

The wings measure 570 (2 ♀♀), 588 ♂ : av. 576 ; bills 305 ♀—355 ♂ : av. 333. One female is in breeding plumage with the upper parts white and the breast feathers lanceolate as in a male *onocrotalus*. The primary shafts, as in the next form, are black.

22 **Pelecanus philippensis crispus** Bruch (Dalmatia) **6** : 273

2 : 2 o ? Bhavnagar. Wings 655, 665 ; bills 345, 390.

Though the feathers of the forehead and the dark shafts of the primaries are similar to those of the previous form, this can be separated by its larger size and the black shafts to the feathers of the scapulars, wing-coverts, and shorter upper tail-coverts.

23 **Sula dactylatra melanops** Heuglin (Burda-Rebschi, Somali Coast) Masked Booby **6** : 287

4 : 3 ♀♀ 1 o ?

All from Bombay, July (2), August, and December.

Wings 420, 420, 412, 410 ; bills 105, 96, 97, 100.

24 **Sula sula rubriceps** Gould (New South Wales, Raine Island, northern Queensland) Redfooted Booby **6** : 286

nil.

25 **Sula leucogaster plotus** (Forster) (Near New Caledonia) Brown Booby **6** : 285

4 : 1♀ 3 o ?

1 *off Hongkong* (wing: 404); 1 *Red Sea* (385); 1 Karwar (408 ; bill 95 mm) ; 1 no data.

The Karwar bird was collected by G. Monteith, I.C.S. ; no date appears on the label, but we have other specimens obtained by him in the same area during 1916 and there seems to be no reason to ignore

an apparently overlooked record. Its range extends into the Red Sea, though this is not suggested by the wording in the SYNOPSIS.

Philips & Sims recently recorded the race *rogersi* Mathews from the Maldives (*JBNHS* **55** : 202), but this race is not accepted either by Vaurie or in the SYNOPSIS.

26 **Phalacrocorax carbo sinensis** (Shaw) (China) Cormorant **6** : 277

11 : 2 ♂♂ 7 ♀♀ 2 o ?

4 *Persian Gulf* ; 1 Baluchistan ; 1 Lucknow ; 3 Bihar ; 1 Malwa ; 1 Nasik.

No. 15002, ♀ from Herbuz, 55 miles east of Panjgur, Baluchistan, has 4 feathers on each side of the tail badly frayed and brown in colour, as against the other feathers which are normal and black. THE NEW DICTIONARY OF BIRDS (1964) p. 488 states that tail feathers (in most species of this family) are moulted in symmetrical pairs and the moult commonly begins with the central pair and proceeds centrifugally. This great disparity in the feathers at one time is very striking. A similar condition exists in No. 21333 a ♀ *P. fuscicollis*, there being 2 faded-brown feathers on one side and three on the other.

27 **Phalacrocorax fuscicollis** Stephens (Bengal) Indian Shag **6** : 279

1 : ♀ Nasik, Maharashtra.

Wing 244. Upper breast white.

28 **Phalacrocorax niger** (Vieillot) (Bengal) Little or Pygmy Cormorant **6** : 280

20 : 8 ♂♂ 10 ♀♀ 2 o ? (3 juveniles).

1 Sind ; 1 Jaipur ; 1 Gwalior ; 1 Gir ; 1 Calcutta Bazar ; 1 Tirunelveli ; 7 Bombay; 1 Nasik ; 3 Bihar ; 2 Oudh, U.P. ; 1 *Burma*.

The amount of white on the chin varies greatly and cannot be linked with sex or locality. According to the FAUNA, the black chin is a character of the breeding plumage.

28a **Phalacrocorax pygmeus** (Pallas) (Caspian Sea)

3 : 1 ♂ 2 ♀♀.

1 *Amara, Iraq* ; 1 *Enzil Gilan, North Persia* ; 1 Gujar Mashkai Kalat, Baluchistan.

The last mentioned specimen constitutes the first record from India (*JBNHS* **62** : 553), having been overlooked for many years.

29 **Anhinga rufa melanogaster** Pennant (Ceylon and Java) Darter **6** : 282

14 : 1 ♂ 11 ♀♀ 2 o ?

1 *Amara, Iraq* ; 2 Gulf of Kutch ; 1 Gujarat ; 2 U.P. ; 1 Rajasthan ; 3 Bihar 1 Malwa ; 1 Nepal ; 1 *Burma* ; 1 no data.

Sp. No. 21388 ♂ from Kutch (July 1962) has its wing quills in moult and was incapable of flight. A ♀ from the same area (No. 22078) has its underparts completely white.

The ♀ from Amara has black underparts with the pure white of the upper breast extending to the chin. It is marked *A. rufus* and is presumably *A. r. chantrei* (Oustalet). It can be matched with No. 15031 from Burma, except that the bases of the black feathers of the underparts are white in the former and dark in the latter. The upperparts of both differ from those of the others, but the Iraq bird is slightly washed with rufous and the other with grey. A bird from Oudh, U.P. (No. 15032) and the Kutch bird referred to earlier (No. 22078) are similar in this respect.

30 **Fregata andrewsi** Mathews (Christmas Island, Indian Ocean) Christmas Island Frigate Bird **6** : 295

nil.

To be removed from the Indian list (see Abdulali, *JBNHS* **57** : 667).

31 **Fregata minor aldabrensis** Mathews (Aldabra Island) Lesser Frigate Bird **6** : 297

1 o ? Quilon, Kerala.

32 **Fregata ariel iredalei** Mathews (Aldabra Island) Frigate Bird **6** : 298

nil.

A specimen obtained near Bombay (*JBNHS* **57** : 668) is exhibited at St. Xavier's High School, Bombay.

33 **Ardea imperialis** Baker (Sikkim Terai, Bhutan Duars) Great Whitebellied Heron **6** : 342

3 : 1 ♂ Naga Hills ; 1 ♀ 1 o ? Duars.

34 **Ardea goliath** Cretzschmar (White Nile, Bahhar Abiad) Giant Heron **6** : 343

4 o ?

3 *Basra, Mesopotamia* ; 1 Khulna, Sunderbans, Bengal.

Only No. 15103, said to have died in captivity in Basra, has the dark rufous underparts of the adult. Its wing and bill (from gape) are 572 and 212 (176 from feathers) as against 590 and 246 (202 from feathers) in the bird from Bengal. The difference in the size of the bill is very noticeable.

35 **Ardea cinerea cinerea** Linnaeus (Europe, restricted to Sweden) Grey Heron **6** : 339

36 **Ardea cinerea rectirostris** Gould (India) Grey Heron **6** : 340

9 : 1 ♂ 6 ♀♀ 2 o ?

3 *Bubiyan Is., Muscat, Baghdad* ; 1 Upper Sind ; 2 Oudh, U.P. ; 2 Gujarat ; 1 South Kanara.

Typical material not being available, it is difficult to decide if *rectirostris* Gould can be distinguished from *cinerea*. The bird from South

Kanara in sub-adult plumage carried a ring placed on it at Kazakhstan (40° 48″N. 70°E), U.S.S.R. (*JBNHS* **59** : 650). The birds from this area are accepted as *cinerea* and this specimen is hardly darker than the others in similar plumage, though both its wing (468) and its bill (129) are larger than in any of the others (wings 418-464 av. 442·5 and bills 113-125 av. 120).

Of the three in adult plumage (Bubiyan Is., Jamnagar, Oudh), the upperparts of the birds from Oudh are palest. Vaurie (1965 : 73) says: ' birds from Iraq and eastward to India are also slightly paler, but in my opinion these populations are best referred to nominate *cinerea* '. He accepts *jouyi* Clark from Seoul, Korea.

37 **Ardea purpurea manilensis** Meyen (Philippines) Purple Heron **6**:337

7 : 5 ♀♀ 2 o ? (3 juv.).

1 Gujarat ; 2 Bombay ; 1 Darbhanga, Bihar ; 1 Trinkut, Central Nicobars ; 2 *Burma*.

37a **Ardea purpurea purpurea** Linnaeus (Philippines)

6 : 1 ♀ 5 o ? (1 juv.).

*Persian Gulf area.*

They include one marked ' Kurna, June/July 1916 Maj. H. Wall '. The locality cannot be traced on the maps available, but snakes were obtained by Col. Wall from this area between January 1916 and January 1917 and it probably refers to Al Qurna at the confluence of the Tigris and the Euphrates.

Vaurie (p. 75) accepts birds from Iraq as of the nominate race and separates *manilensis* by its almost completely black lower belly, against variegated with chestnut in the present form. These differences are consistent in the specimens available and, considering that Meinertzhagen (*Ibis* 1920 : 179) and Christisen (*JBNHS* **43** : 486) have both identified specimens from Baluchistan as of this race, it would appear that though it is omitted from the SYNOPSIS it has a place in the Indo-Pakistan avifauna.

38 **Butorides striatus javanicus** (Horsfield) (Western Java) Little Green Heron **6** : 357

18 : 5 ♂♂ 7 ♀♀ 6 o ? (7 ad. with grey underparts; 5 sub-ad. brownish below ; 6 imm. with streaked breasts.)

1 Ambala, Punjab ; 1 Kutch ; 1 Saronj, M.P. ; 4 Bombay, 1 Kihim, Kolaba, 1 Khandala, 2 Ratnagiri ; 1 North Kanara ; 1 Darbhanga, 1 Chapra, Bihar ; 3 *Burma* ; 1 *Rabeng, Siam.*

In my Andaman paper (*JBNHS* **61** : 501) I had referred to Biswas separating Indian birds from those from Java by their larger size and some differences of colour (one measurement of 174 mm. was a typographical error for 184). The five birds from Bihar and Burma are larger than those from other parts of India :

| | Wings |
|---|---|
| 5 Bihar and Burma | 179-185 av. 182·8 |
| 13 others | 167-181 av. 171·3 |

Both sexes and birds in different plumages are measured together as there does not appear to be any difference in size between them. Some birds have one wing as much as 5 mm. longer or shorter than the other. There is great variation in plumage; some birds have the primaries in one wing of different colour from those in the other, and beyond confirming that the eastern and Burmese birds do appear larger than those from other parts of the country, I am unable to venture an opinion. These larger birds may perhaps be listed as Bonaparte's *chloriceps*.

39 **Butorides striatus spodiogaster** Sharpe (Andamans and Nicobars) Little Green Heron **6** : 359

12 : 4 ♂♂ 7 ♀♀ 1 o?
3 Betapur, Middle Andamans ; 2 Car Nicobar ; 7 Central Nicobars.

40 **Butorides striatus didii** Phillips & Sims (Male Island, North Male Atoll, Maldive archipelago)

nil.

This was described in 1958 and is an addition to the 19 races listed in Peter's CHECK-LIST OF THE BIRDS OF THE WORLD (1929).

41 **Butorides striatus albidulus** Bangs (Suadiva Atoll, Maldive Islands)

nil.

Southern atolls of the Maldive archipelago.

42 **Ardeola grayii grayii** (Sykes) (Dukhun) Pond Heron or Paddy-bird **6** : 354

31 : 16 ♂♂ 11 ♀♀ 4 o? 1 pull. ; 3 in breeding plumage.
17 Bombay, 4 Ratnagiri, Maharashtra ; 1 Nilambur, Kerala ; 2 Kanyakumari District, Madras ; 2 Bastar, M.P. ; 1 Manbhum, Bihar ; 1 Calcutta ; 1 Andamans ; 2 *Burma*.

The males are larger than the females, eight of each sex from around Bombay having their wings 195-218 av. 208, and bills 51 (next 60) to 68 av. 61·5 against 180-203 av. 193, and 55-60 av. 57·5, respectively.

42a **Ardeola grayii phillipsi** Scheer (Addu Atoll, Maldives)

nil.

Described from the Maldives in 1960 as ' they tend to be whiter on the primaries ' (Vaurie 1965 : 63). It is significant that two males from Ratnagiri, Maharashtra, West Coast, Nos. 20973 and 22307 differ from all the others, including those in breeding plumage, in having white shafts to all the primaries. In *ralloides* all adults have them white and this is quoted as an index of maturity.

43 **Ardeola bacchus** (Bonaparte) (Malay Peninsula) Chinese Pond Heron **6** : 356

nil.

EL **Ardeola ralloides** (Scopoli) (Krain)

6 : 1 ♂ 2 ♀♀ 3 o ? (1 juv. ; 3 in breeding plumage).

1 *Medina* ; 5 *Persian Gulf.*

EL **Bubulcus ibis ibis** (Linnaeus) (Egypt)

2 : 2 ♂♂.

*Sheik Saud, Mesopotamia.*

Both are in non-breeding plumage and I cannot separate them from Indian birds.

44 **Bubulcus ibis coromandus** (Boddaert) (Coromondel) Cattle Egret **6** : 349

23 : 12 ♂♂ 10 ♀♀ 1 o ? (4 in breeding plumage).

1 Meerut, 1 Shahjahanpur, U.P. ; 1 Rajputana ; 2 Gujarat ; 15 Bombay ; 1 Nasik ; 1 Andamans ; 1 *Burma.*

Of the four in breeding plumage, the three sexed are males. Some skins with slight traces of the breeding plumage on the upperparts are marked females.

Though the smallest wings of both sexes are identical, the males are larger—233-263 av. 251, against 233-253 av. 242 in the females. Curiously, their bills and tarsi do not show any differences.

45 **Egretta alba alba** (Linneaus) (Sweden) Large Egret **6** : 345

1 o ? Manchar Lake, Sind.

Wing 447 ; Bill from feathers 126, from gape 163 ; Tarsus 215.

46 **Egretta alba modesta** (Gray) (India) **6** : 346

8 : 3 ♂♂ 4 ♀♀ 1 o ?

1 Kutch ; 3 Gujarat ; 2 Bombay ; 1 Andamans ; 1 *Burma.*

The males are larger than the females and the Andamans bird was originally wrongly identified as *intermedia* (Abdulali, *JBNHS* **62** : 554).

47 **Egretta intermedia intermedia** (Wagler) (Java) Smaller Egret **6** : 347

5 : 2 ♂♂ 2 ♀♀ 1 o ?

1 Saugor, C.P. ; 1 Bharatpur ; 3 Bombay.

All with yellow bills, except black in a ♀ dt. 17-7-1959 in which the dorsal plumes project far beyond the tail. The sexes show no difference in size and measure :

| Wing | Bill | Tarsus |
|---|---|---|
| 296-305 av. 301 | 70-77 av. 73 | 99-110 av. 105·4 |

The measurements in the FAUNA (**6** : 347) are erroneous (see Abdulali, *JBNHS* **62** : 554).

[48 **Egretta intermedia palleuca** Deignan (Muang Chiang Rai, Siam)

This race from Thailand, Burma, and eastern India separated for having the bill yellow at all seasons is not now accepted. Egrets and herons change the colour of their bills and other soft parts for very short and transitory periods.]

49 **Egretta garzetta garzetta** (Linnaeus) (North-east Italy) Little Egret **6** : 348

7 : 4 ♂♂ 2 ♀♀ 1 o?

1 *Baghdad*; 1 Gujarat; 1 Gondia, Bhandara Dist., 3 Bombay, Maharashtra; 1 Kanyakumari Dist., Madras.

50 **Egretta gularis schistacea** (Hemprich & Ehrenberg) (Red Sea) Indian Reef Heron **6** : 353

11 : 6 ♂♂ 3 ♀♀ 2 o?

1 *Muscat*; 1 Indus Delta, Sind; 3 Kutch; 4 Bombay, 1 Nasik, 1 Ratnagiri.

The males are slightly larger than the females.

There is no all-white specimen available, but two are dark slaty black with a prominent patch of pure white wing-coverts about half way down the edge of the wing. One is a male from Kutch and the other an unsexed bird from Muscat which, being larger than all the others (wing 293, bill 99), is probably also a male. A third is almost as dark but lacks the white on the wing. The colours of the feet are not noted on all, but the bird from Kutch had them bright yellow (as in the Little Egret, *E. garzetta*) and the same was noted in another dark bird with a white wing patch recently seen (October 1965) at Rewas, Alibag, Maharashtra.

The other specimens are in varying shades of lighter grey with an unequal amount of white on the underparts.

Ripley and Vaurie (1965, p. 70) both state that the form occurring in India is *schistacea* (Type locality : El Tor, Sinai Peninsula), but the latter adds that it is larger than the nominate *gularis*. His measurements (marked with asterisks below) however, compared with those of the few available, show that the wings of Indian birds are nearer to *gularis* and the bill and tarsus intermediate between the two races; the single unsexed bird from Muscat agrees with *schistacea* :

| | Wing | Bill | Tarsus |
|---|---|---|---|
| * 10 ♂♂ *schistacea* | 272-311 av. 288·3 | 94-103 av. 98·5 | 92-116 av. 103.55 |
| 6 ♂♂ Indian | 272-285 av. 276 | 85- 98 av. 92 | 97-101 av. 99 |
| * 10 ♂♂ *gularis* | 263-285 av. 277·1 | 80- 94 av. 84·7 | 80- 95 av. 89. 5 |
| 1 o ? Muscat | 293 | 99 | 101 |

With the material available it is not possible to suggest any conclusions.

51 **Egretta sacra** (Gmelin) (Tahiti) Reef Heron **6** : 351

7 : 5 ♂♂ (including 2 white) 2 ♀♀.

1 Middle Andamans ; 5 Car Nicobar ; 1 Camorta, Central Nicobars.

52 **Nycticorax nycticorax nycticorax** (Linnaeus) (Southern Europe) Night Neron. **6** : 359

20 : 8 ♂♂ 5 ♀♀ 7 o ? [1 ch. ; 6 juv. ; 12 ad. ; 1 albino (Bihar)].

5 *Mesopotamia* and *Persia* ; 2 Chitral ; 1 Punjab ; 1 Gujarat ; 7 Bombay ; 2 Bihar ; 1 *Burma* ; 1 *Peking, China.*

The 6 adults collected from January to March have a green gloss on the upperparts while the same number from April to November do not.

53 **Gorsachius melanolophus melanolophus** (Raffles), (Western Sumatra). Malay or Tiger Bittern **6** : 361

6 : 1 ♂ 2 ♀♀ 3 o ? (4 in adult plumage, 2 juv.).

2 Mysore ; 3 Karwar ; 1 Ceylon.

54 **Gorsachius melanolophus minor** Hachisuka (Katchel Island, Nicobar Islands)

nil.

55 **Ixobrychus minutus minutus** (Linnaeus) (Switzerland) Little Bittern **6** : 364

10 : 3 ♂♂ 3 ♀♀ 4 o ? (5 in adult male plumage ; 1 female ; 4 juv.).

4 *Mesopotamia* ; 5 Kashmir ; 1 Bombay.

The register included under this species 4 birds, ♂, ♀ and o ?, which have pale buff margins to the feathers of the upper surface, are smaller (wing 125-137 av. 131, against 142-151 av. 146), and do not have a black cap ; they also have the first primary shorter than the second, as in the specimens of *sinensis* available, against the first and second being equal in 9 of the 10 *minutus*, a character which is mentioned in the BR. HANDBOOK (**3** : 165). I think they are *sinensis* and have listed them accordingly.

56 **Ixobrychus cinnamomeus** (Gmelin) (China) Chestnut Bittern **6** : 367

19 : 7 ♂ 6 ♀ 6 o ? (7 all-chestnut ; 6 juv)

1 Sind ; 1 Daman, Gujarat ; 4 Bombay ; 1 Poona ; 3 Kanara ; 1 Kottayam, Kerala; 2 Tirhut, Bihar ; 2 Calcutta Market ; 1 Assam ; 1 Trinkut, Central Nicobars ; 1 *Burma* ; 1 *Ceylon.*

The 7 all-chestnut birds include a ♀. From the material available it is not possible to understand the sequence of plumages.

57 **Ixobrychus sinensis** (Gmelin) (China) Yellow Bittern **6** : 365

11 : 4 ♂♂ 5 ♀♀ 2 o ? (2 ad. ♂♂ ; 1 ad. ♀).

1 *Kashgar*, 1 *Burma* ; 2 Sind ; 1 Chapra, Bihar ; 1 Kutch ; 2 Bombay ; 1 South Andamans ; 2 Trinkut, Central Nicobars.

58 **Dupetor flavicollis flavicollis** (Latham) (India) Black Bittern **6** : 368

1 : ♂ *Ataran, Burma.*

Bill 85 (69-82 in FAUNA).

59 **Botaurus stellaris stellaris** (Linnaeus) (Europe, restricted to Sweden) Bittern **6** : 370

14 : 7 ♀♀ 7 o?

2 *Mesopotamia* ; 1 *Shiraz, Persia* ; 4 Sind ; 3 Punjab ; 1 Kutch ; 1 Agra ; 2 Bombay.

Curiously, the seven sexed specimens are all females. The unsexed birds have their wings and bills slightly larger and may include males.

60 **Ibis leucocephalus** (Pennant) (Ceylon) Painted Stork **6** : 331

6 : none sexed (5 ad. ; 1 in juvenile plumage, but not smaller in size).

1 Bhavnagar ; 1 Bombay Harbour ; 3 Baghowni, Bengal ; 1 no data.

The range of measurements is slightly different from that in the FAUNA.

Wing 490-523 av. 505 (490-510) ; tarsus 205-242 av. 225 (240-250) ; culmen 230-256 av. 246 (252-278).

Vaurie (1965 p. 86) refers to Ticehurst's records from Baluchistan, which have been omitted in the SYNOPSIS.

61 **Anastomus oscitans** (Boddaert) (Pondicherry) Openbill Stork **6** : 333

4 : 3 ♂♂ 1 ♀.

1 ♂ and 1 ♀ are in juvenile plumage with almost no gap in bill.

1 Malwa, M.P. ; 1 Baghowni, Bengal ; 1 Darbhanga, Bihar ; 1 *Burma*.

62 **Ciconia episcopus episcopus** (Boddaert) (Coromandel Coast) Whitenecked Stork **6** : 324

12 : 7 ♂♂ 4 ♀♀ 1 o?

1 Malwa, 1 Gird, M.P. ; 1 Ratnagiri ; 7 Bihar ; 1 Nepal ; 1 *Burma*.

The males have wings (471-523 av. 493) slightly larger than the females (450-516 av. 485).

63 **Ciconia ciconia ciconia** (Linnaeus) (Sweden) White Stork **6** : 320

4 : 4♂♂.

1 *Persian Gulf* ; 1 Patan, Satara, Maharashtra ; 2 Baghowni, Bengal.

64 **Ciconia ciconia asiatica** Severtzov (Turkestan) White Stork **6** : 322

nil.

Biswas in his comments on the SYNOPSIS (*JBNHS* **60** : 680) says that Severtzov's *asiatica* is synonymous with nominate *ciconia* and presumably suggests that the remarks regarding *asiatica* wintering in ' Burma, Assam, East Pakistan, south to the Sunderbans ' should apply to *boyciana* (Swinhoe) as in the FAUNA (**6** : 322). Vaurie (1965 : 64) has accepted *asiatica* as a good race with a larger bill (184-235 av. 215 against 169-206 av. 189, all males from skull) and expressed the opinion that *boyciana* is a different species, separated by its black bill, red skin on the face, and larger size. From the references immediately available to me, I have

no evidence of the occurrence of the White Stork in that area, except for Stuart Baker's statement (loc. cit.) that he saw a pair with black bills in Khulna in Bengal. Smythies in BIRDS OF BURMA (1953 : 520) specifically states there are no records of the White Stork from Burma, while it is mentioned in the SYNOPSIS.

La Touche in HANDBOOK OF BIRDS OF EASTERN CHINA (1934) measures the wings of 2 *boyciana* as 665 and 680 against 590-614 av. 600 in the 3 males of nominate *ciconia* from India. The bills are also 225 against 198-202 (from feathers) in the Bombay specimens.

65 **Ciconia nigra** (Linnaeus) (Sweden) Black Stork **6 :** 323

3 o ?

1 *Persian Gulf*; 2 Baghowni, Bengal.

66 **Xenorhynchos asiaticus asiaticus** (Latham) (India) Blacknecked Stork **6 :** 326

3 : o ? 2 adult ; 1 imm.

1 Gwalior ; 2 Baghowni, Bengal.

67 **Leptoptilos dubius** (Gmelin) (India) Adjutant **6 :** 327

nil.

68 **Leptoptilos javanicus** (Horsfield) (Java) Lesser Adjutant **6 :** 329

nil.

69 **Threskiornis melanocephala** (Latham) (India) White Ibis **6 :** 314

2 : 1 ♂ 1 o ? Both immature, with grey-feathered heads.

1 Bhuj, Kutch ; 1 no data.

The FAUNA (6 : 314) measures the bills 139-170 ; both the present specimens are 183 from feathers, which measurement would increase as the feathers recede.

70 **Pseudibis papillosa papillosa** (Temminck) (India) Black Ibis **6 :** 316

6 : 1 ♂ 4 ♀♀ 1 o ?

1 Sind ; 1 Ahmedabad ; 1 Meerut, U.P. ; 1 Malwa, C.I. ; 1 Darbhanga, Bihar ; 1 Baghowni, Bengal.

The male, wing 360 (365-400), bill 127 (138-158), tarsus 60 (75-85), is smaller than the range indicated in the FAUNA.

71 **Plegadis falcinellus falcinellus** (Linnaeus) (Austria and Italy) Glossy Ibis **6 :** 318

4 : 1 ♀ 3 o ?

1 Manchar Lake, Sind ; 1 Honavar, North Kanara ; 1 Darbhanga, Bihar ; 1 no data.

72 **Platalea leucorodia major** Temminck & Schlegel (Japan) Spoonbill **6 : 311**

4 : 1♂ 1♀ 2 o?
1 Sind ; 2 Nasik, Maharashtra ; 1 no data.

Stuart Baker in the FAUNA states this is a poor subspecies while Vaurie (p. 78) includes this as a synonym of the nominate form.

73 **Phoenicopterus roseus** Pallas (Mouth of the River Volga, South Russia) Flamingo. **6 : 373**

13 : 3♂♂ 2♀♀ 8 o? [5 ad., 4 juv. (marked * below), 4 ch.]
1 *Aden**, 1 *Persian Gulf** ; 3 Sind ; 4 Rann of Kutch (ch.) ; 2 Gulf of Kutch ; 1 Bhayander*, 1 Manmad *, Maharashtra.

The 2 males have larger wings, 430-447 av. 438 and tarsi 335-365 av. 350 against 398-435 av. 416 and 280-365 av. 322 in the females. The juvenile with the smallest 339 wing, and 216 tarsus (its bill is 129 and almost full grown), presumably flew to Bhayander near Bombay, from Kutch, the nearest breeding place, which is almost 400 miles away.

Two adults obtained in August have pink bills, while the three others, all collected in December, do not have any pink. The colours in the 'dry' state may be of little significance.

74 **Phoeniconaias minor** (Geoffroy) (East Africa) Lesser Flamingo. **6 : 375**

2 : 1♀ 1 o?
1 Bombay Zoo (imm.) ; 1 Gulf of Kutch.

(*to be continued*)

# Reviews

1. NATURE'S PARADISE. By Jen & Des Bartlett. pp. 360 ($32 \cdot 5 \times 24$ cm.). With many coloured, and black and white photographs. London, 1967. Collins, St. James Place. Price 5 *gns.*

The only way for a layman to describe this book is to describe it carefully. It is one of these large, opulent coffee table productions; it belongs to the class where, a few years ago, art and architecture had the field to themselves, but where natural history is gaining rapidly. The authors, a husband and wife team of photographer-naturalists went to Africa for 6 months and stayed ten years studying the flora and fauna, taking photographs and making films for the BBC.

The present volume—heavily conservation-biased, is really a book of photographs, coloured as well as black and white. It is divided into sections according to the type of country. Beginning with the coral reef on the coast, we go through dry thornbrush, open bush and woodland, the plains, the forest, lakes, and so on. Each section is introduced by a few pages of text which while it does not attempt to teach the reader too much, links the habitat with the inhabitants, tells enough for us to interpret and understand the photographs intelligently. The authors' attempt is not so much to amaze us with their magnificent pictures of individual animals, as to enable us to connect their physical characteristics with their food, habits, and environment. It is this subtle line of education which makes this book more valuable than just a luxury book of splendid pictures.

As far as the photographs themselves go, one still finds oneself marvelling at modern technology. To say this is not to belittle the talent, hard work and perseverance of the authors. Those seemingly effortless close-ups, with every hair and bristle clear and alive, must have meant many hours of patience supported by years of experience and expertise. There is a portrait of a panther, showing each detail of the fly on his nose; at the other end of the scale are slugs, bugs, the minute inhabitants of shallow pools, each scarcely visible bit of life filling a whole quarto page in accurate delineation. Night prowlers and those that live in dark small caves have also somehow been made to 'sit' for the author. Fortunately, Des Bartlett is not one of those writers who inflicts a blow by blow account of the

history of each picture. He leaves us free to imagine that he was out for a walk when a——happened to run up and posed in front of him. Luckily he had a camera handy.

The pattern of the book is broken to describe, in words and pictures, some of the operations of capturing animals either to save them from drowning when the Kariba Dam was built, or to transport them to stock new reserves, and parks. The speed with which emergency operations were carried out, the enthusiastic and efficient help from the highest quarters are almost unbelievable to those of us accustomed to Indian conditions. The sport of shikar has, it seems, turned upon itself; and the sportsman with a gun is now replaced by the man with rope and harness, catching and resettling animals in safer areas. Future generations will owe much to him.

L. F.

2. MONGOOSES—THEIR NATURAL HISTORY AND BEHAVIOUR. By H. E. Hinton and A.M.S. Dunn. pp. 144 (15× 22·5 cm.). With 16 plates and 26 figures. London 1967. Oliver & Boyd. Ltd. Price 42*s*.

The snake-killing propensities of the mongoose have always attracted man's attention and the animal has a prominent place in Indian and Egyptian mythology. The present book is a welcome attempt to bring together all that is known of the 36 species of the subfamily Herpestinae which occur in the African and Oriental regions, and of which 6 are from our area.

The titles of the 17 chapters, 'In the West Indies', 'In Ancient Egypt', 'Life Span', 'Play', 'Indian Folk Tales', 'Colour Vision', etc. indicate the nature of the information collected but the very fact that some of the chapters, e.g. Mongooses as Pets, cover little more than a page, is an index of how little is known about them.

The reports on the introduction of the mongoose into Hawaii, the West Indies and into other parts of the world for the control of snakes or rats are quoted in some detail, but as to results they are conflicting and it is not possible to be certain if the introductions can be said to have been successful. The mongooses ate the rats and snakes, but did great damage to poultry and ground-nesting game birds and were also accused of killing newly-born deer. The black rat's damage to sugarcane was reduced, but the rat became arboreal and transferred its attention to cocoa. Barbados had to have its

Mongoose Destruction Act of 1904, while Trinidad paid bounties for the destruction of over 30,000 mongooses in 1928 and 1929. All this stresses the complex nature of such introductions and the danger and uncertainty accompanying them.

The list of 259 references at the end includes about 30 from the *Journal* of the Bombay Natural History Society many of which appeared as Miscellaneous Notes, thus drawing attention to the importance of recording the smallest piece of information which adds to recorded knowledge. Notes, which at first sight appear of little value, can often form the basis of much further research by those who have the opportunity.

The book makes interesting reading and may prompt readers with experience of Indian conditions to fill in some of the many gaps in our knowledge.

H. A.

3. GENERAL ENTOMOLOGY FOR AGRICULTURAL STUDENTS. By H. L. Kulkarny. pp. xv+291 (22×14 cm.). With 198 figures. Bombay, 1967. Asia Publishing House. Price Rs. 15/-.

The book contains 32 chapters, the first 17 of which contain general information regarding insect life, including their anatomy, physiology and classification. One chapter each in this section is devoted to beneficial and harmful insects. For a general reader and for a student of entomology as well, this portion of the book is enlightening. The chapter on how to collect insects could have been more elaborated by adding a paragraph to it on preservation of insects. This subject has been touched slightly at the end of the chapter but one would think it deserved better treatment in view of the importance it has gained in recent years. An entomology student, general or agricultural, would surely look to such books for guidance in this direction.

The next 15 chapters contain brief descriptions of the orders of insects and some of their important families, with a brief study of their life cycle. Names of insects, harmful to agriculture and their host plants are mentioned under each family. There is neither a description of the insect, their life history and habits nor is there a mention of the part of the plant attacked by each. One would surely expect to find this information in an agricultural entomology book. Again, no mention is made of the various control measures in

use against the pests, cultural, mechanical, chemical etc. or the apparatus used for the same. In fact it should form an important section in any book dealing with agricultural entomology.

The book contains a large number of illustrations. This is as it should be, but the figures in some cases are misleading. Some of the figures are drawn without proper care, some are partially, and some totally, incorrect. Fig. 71 *Periplaneta americana*, and Fig. 105 *Bombyx mori* are poor representations whereas Fig. 106 butterfly of the castor leaf eating caterpillar is not that of a butterfly but of a moth.

In the foreword it is stated that the English books, now prescribed for Indian students but written for foreign students should be replaced by Indian books suited to local conditions. It is difficult to see how this ideal is being fulfilled by the book under review as nothing of particular interest to India is discussed in it except that it mentions some Indian agricultural pests. In addition the author recommends to the students, for further information, under each chapter, reading of foreign books only, almost to the complete exclusion of Indian agricultural entomology books, periodicals, reports etc. which though few, are worth studying as they are full of information.

N. T. N.

4. ECOLOGICAL ENERGETICS. By John Phillipson. pp. 57 (21·5 × 14 cm.). With 20 text-figures and 9 tables. London, 1966. Edward Arnold (Publishers) Ltd. Price 12*s.* 6*d.* Hard cover, 7*s.* 6*d.* Paper back.

Science, Sir Julian Huxley said, has two functions, viz., comprehension and control. To achieve scientific exploitation of the limited sources of nature man must have a complete understanding of energy flow within ecosystems. John Phillipson's new book is a clear and concise introduction to this specialized field.

Energy is defined here as the capacity to do work. Nuclear transmutations within the sun release energy on which life on earth depends. The photons of light energise electrons in the chlorophyll molecules and in the course of a cyclic reaction the plant cells extract this energy and store it. To complete photosynthesis solar energy is used to build energy rich glucose from energy poor carbondioxide and water. In respiration energy is recovered from glucose and used

to do work. Such energy transformations within the living cell obey the first and second laws of thermodynamics.

The living things as well as the physical features of the environment, together form the ecosystems. There are autotropic organisms which can synthesize organic materials using inorganic chemicals and energy from the environment. The heterotrops utilize the tissues of other organisms as source of energy. From the quantity of solar energy available to plants only 1-5 per cent is used in photosynthesis, the rest being lost as heat of evaporation and sensible heat. The synthesis of plant materials by autotrophs is termed primary production and the amount stored by them per unit area per unit time, gross primary production. Gross primary production minus the energy spent for respiration is termed net primary production. The various plants and the animals of an ecosystem can be sequentially placed into food chains of plants, herbivores, and carnivores. By suitable techniques like introduction of radioactive isotopes of phosphorus into plants which form the initial food source the structure of food chains can be elucidated. The food chains of a particular ecosystem with its complex webs can be represented diagrammatically in ecological pyramids on the bases of numbers, biomass, or energy. The author prefers the pyramid of energy, which represents energy in kilocalories used by the different feeding types in a square metre over one year, as a unifying and unambiguous concept. The productivity of different regions can thus be compared in terms of energy.

The calorific values of the different species can be determined by combusting small quantities of materials from each, in miniature bomb calorimeters. In laboratory studies of ecological efficiency, one can use the concept of gross ecological efficiency which is a ratio of the calories of prey consumed by the predator to the calories of food consumed by prey. Laboratory studies by Slobodkin on Chlamydomonas/Daphnia/Man systems showed a maximum gross ecological efficiency of the order of 13 per cent. For natural ecosystems, ecologists suggest a value of the order of 10 per cent as the most probable. Assuming a constant gross ecological efficiency of 10 per cent presupposes that for every 1000 calories of plant material consumed by herbivores only 100 calories are passed on to the carnivores, and of those only 10 reach the top carnivores. Ecologically the most economic use of solar energy when converted into protein is human consumption of herbivore flesh. Beef cattle raised on grass land consume only one-seventh of the total primary production, the rest being consumed by the herbivores and decomposers which are of no direct food value. The amount of plant

material converted into food proteins can be increased by adopting modern methods of farming and animal husbandry such as strip grazing, and raising of chickens, calves, and pigs in specially constructed buildings. Livestock should be used for food at a period when their growth efficiency is maximum, i.e. when they are youog. To meet the food requirements of an increasing world population both farming methods and feeding methods and feeding habits of man have to be changed. Production of protein eaten by man can be increased by preferring high individual growth efficiency and the maximization of food energy reaching the livestock. Farming of the sea and use of unconventional materials such as starfish as poultry feed are among the steps recommended by ecologists.

Throughout the book, the stress is on the thermodynamical aspects. The formulations of energy flow at the different trophic levels are discussed in some detail. The specialist student for whom the book is meant will find the book immensely useful. Anyone interested in the food economy of the future will find the last chapter specially interesting.

D. N. M.

5. SEAWEEDS AND OTHER ALGAE. By C. L. Duddington. pp. 207 (14×22 cm.). London, 1966. Faber and Faber Limited. Price 36*s*. net.

This little book gives a general over-all picture of all types of algae such as freshwater forms, soil forms, epiphytic, endophytic and parasitic forms in addition to seaweeds. Written in a lucid and effortless style, and supplemented by excellent plates and simple line drawings, the book condenses a wealth of information within its short compass of 207 pages. A useful glossary enhances the value of the publication.

The dust cover indicates that the aim of the book is to acquaint the intelligent general reader with this absorbing subject, as also to furnish 'background reading' to the student of elementary botany in order to bolster his knowledge of the algae. The book has more than succeeded in its objective, for the fairly up-to-date matter it contains should prove equally useful to, also, the student of advanced botany.

The majority of the chapters deal with the general characteristics of the major groups of the algae together with brief life histories of

judiciously selected forms belonging to them. Although the types selected are ones with which most students of botany are familiar, interest is, nevertheless, sustained by the inclusion of significant information from specialized works, apart from little-known facts, not generally found in text-books, about these types.

Unfortunately, because of the need for economy of presentation in a book of this size, and, perhaps, because of a desire to widen its popular appeal, important stages in life histories are cursorily mentioned or occasionally overlooked. To give only one example—the manner of formation of autocolonies in *Gonium*, *Pandorina* and *Eudorina* is not clearly explained. Evolutionary tendencies and phylogenetic relationships are also not discussed. Such omissions are understandable and, in no way, detract from the merit of the book.

The remaining chapters are concerned with the physiology, ecology and uses of algae. Containing valuable data collated from various sources, these chapters make fascinating reading and contribute to the special appeal of the book to the curious layman and its specialistic flavour to the avowed student of botany. To the several general books on algae, this one is certainly a welcome and commendable addition.

E. G.

6. COMMON BIRDS. By Sálim Ali and Laeeq Futehally. pp. x+118 (14×20 cm.). With 97 coloured plates. New Delhi, 1967. National Book Trust, India. Price Rs. 9 (paper back).

COMMON BIRDS by Sálim Ali and Laeeq Futehally is a very welcome addition to the National Book Trust series.

In this small book, nearly 100 common birds are described. It opens with an introduction followed by three important chapters entitled (i) Ornithology and Birdwatching (ii) Reproduction and (iii) Migration. They cover a wide range and provide a rich background of knowledge required for the study of birds. Beginning with an explanation of the system of classification of birds, the authors trace the history of Indian Ornithology, and offer instructive suggestions for field identification of birds. They explain how the physiological readiness for reproduction in birds is adapted to an assurance of an optimum food supply, which again depends upon the seasonal cycle. The chapter on migration is particularly stimulating because Dr. Sálim Ali is a pioneer in the field of bird ringing in India and

has been carrying on this work for the last ten years or more. Thanks to his initiative and leadership, more than twenty thousand wagtails, several thousand Spanish Sparrows, ducks and waders have been ringed by the Bombay Natural History Society. (Several important recoveries have been reported mainly from the U.S.S.R.).

For the classification, the authors have adopted the Wetmore order. Each family has been assigned a brief introductory section. The descriptions of individual birds leave nothing to be desired and contain a wealth of information. The style is lucid and entrancing. The admirable text is supplemented by numerous coloured illustrations borrowed from the earlier editions of Dr. Sálim Ali's BOOK OF INDIAN BIRDS. A few of them are new. Almost every bird is illustrated.

The printing and get-up are of high quality, the format is of a convenient size and the quality of binding ensures that the book opens flat for easy reference. The price of Rs. 9 is very reasonable considering the profusion of illustrations and the quality of printing and binding. The book is also available in hard cover.

There is a crying need for trained field ornithologists who should study different aspects of bird life, such as migration, breeding biology, population study, role of birds in agriculture etc. COMMON BIRDS will help beginners to learn to recognise with confidence the common birds of their locality. It would appeal equally to seasoned ornithologists. A book like this richly deserves wide circulation.

U. G.

# Miscellaneous Notes

## 1. NOTES ON THE BIHAR DROUGHT

We recently revisited the Palamau National Park and stayed in one of the attractive forest bungalows in an adjoining block. This bungalow lay in the centre of an area of about two hundred square miles in which we felt we had come to know every hill and *nullah*, and every bump on the jeep tracks for miles around. Almost overnight the jungle had become unrecognizable, for lush green grass hid the tracks while the vegetation had thickened and become almost impenetrable. Not so very long ago we had seen this jungle as a barren waste, a place of terrific burning heat during the day-time where even the sparse shade offered by the leafless trees was unbearable—and in this heat Bihar had faced the worst drought in living memory.

During the drought, coming after the failure of two monsoons, the water level had fallen. It was only with the aid of the powerful Halco drills donated by UNICEF, which could bore a hundred feet through rock in a few hours, that water could be reached at all, and pumps put in for the villages. Huge aid schemes came into action for the famine struck people of the State. No outside aid however was available for the unprotected wild life, until in answer to a letter of appeal the R.S.P.C.A. in London donated £1000 through the Animal Welfare Board in Madras. £500 of this money was given to the Bihar S.P.C.A. and £500 came to the Save the Wild life Fund which we had started in Calcutta.

The Forest Department, aware of the danger to wild life, had started a system of filling water tanks by a jeep tanker in the small sanctuary at Betla. Large herds of gaur and chital could be seen congregated in the mornings and evenings around these waterholes. Mr. Shahi, the Chief Conservator of Forests, Bihar, who is a naturalist, photographer and keen wild life conservationist, did all in his power by touring the vast areas of forest in the State to inspect and encourage the digging of water-holes.

Our task in the comparatively small area allocated to us was formidable for here water-holes already dug had either dried up or contained only an inch or so of murky water. These small water-holes situated often at a distance of ten miles apart were ringed with poacher's hides. The local poachers, taking full advantage of the situation, were responsible for more deaths than the drought. There was no time to build the cement tanks we had planned, and with the co-operation of my hus-

band's firm, Andrew Yule & Co., who had started a scheme to deliver water to the villages, lorry loads of drums were sent to Palamau from Calcutta. These drums were cut lengthwise and installed in *nullahs* where the water-holes had dried up, and where further digging had failed to reach water. We had organized earlier the digging of a tank in the dry river bed of the Auranga, where water could be pumped from an underground stream to fill the drums and water tanks hauled by the company jeeps. The organization of delivering water had then to be operated daily and this proved to be hot, hard work. It was gratifying to see from the fresh slot and pugmarks around our water troughs in the mornings that thirsty sambar, chital, barking deer and the occasional tiger and leopard had come immediately to drink. In the daytime a myriad of birds congregated around the troughs—drongos, paradise and whitebrowed flycatchers, white-eyes, the spotted and rufous doves, redvented and whitecheeked bulbuls, pittas, orioles, bee-eaters, junglefowl and peafowl—to name only a few, we saw with open beaks and obviously suffering from the extreme heat. Chital we saw in the day-time were open-mouthed and panting, while the normally fat wild pig looked half starved.

With only four jeeps to cover the two hundred square miles allotted to us, the daily delivery of water to villages and filling water troughs took from dawn until dusk. Young Assistants from the Calcutta Office and two British V.S.O.'s volunteered for this work. By evening everyone was exhausted and our forest bungalow was a welcome place of rest. But the nights were often disturbed by our endeavours to stop illegal poaching. Hides and machans had continually to be destroyed and were as continually rebuilt by the poachers. We tried to catch these men by waiting near the water-holes, or creeping up on them in the dark. Although they were too clever for us, they must have been aware of our efforts for the shots at night became less frequent. The Forest Department have taken strong measures to enforce the law and protect the animals of the beautiful sanctuary at Betla. Elsewhere the scale of the poaching astounded us by its magnitude and this side effect of the drought caused the greatest damage. We learnt from the villagers who worked for us, and others whom we had helped, that the poaching is done by headmen shooting with licensed shot guns and muzzle loaders. The meat of deer and occasionally gaur, is sold mainly to lorry drivers who, in turn, profit by selling to restaurants on the Grand Trunk Road and in the towns. To quote from a book written many years ago by a Forest Officer, the Hon. James Best—' The activities of the local poacher is mainly responsible for the disappearance of game in India '.

Licenses for guns given to headmen to protect the crops, are being continually misused for the slaughter of wild life for profit. It is the

opinion of most of the people I have met that these guns should by law have sawn off barrels. A special force of game wardens could also be formed to help stop the destruction of wild life by illegal shooting.

The beautiful jungles of Palamau always notoriously short of water in the summer can only conserve its wild life in the years to come by the building of properly maintained protected watering places, so that people and animals alike can never again be struck by the great tragedy of drought.

14, Ballygunge Park Road, ANNE WRIGHT
Calcutta,
*November* 24, 1967.

## 2. CAN YOUNG BATS COMMUNICATE WITH THEIR PARENTS AT A DISTANCE?

I write to report an experience similar to the one reported by me in August 1965 at page 539 of Volume **62** of your *Journal*. Once more, though it was in a different house, the bats had made their home in the electric meter box. This time there was only one young one and it fell to the floor at about 7 p.m. I put it on the cement floor near my small wicket gate and, switching on the verandah light, I settled down to keep watch. Immediately, the bat began to move and wriggled its way towards the verandah, a distance of about seven yards. Reaching the steel door-mat it wriggled halfway across. Then, evidently not liking the feel, it turned about and went back to the gate, where it settled down peacefully. About fifteen minutes later it repeated the performance, and again settled down. Half an hour thereafter, when two adult bats appeared and made six or seven low sorties over it, the baby suddenly came to life with renewed energy, not only crawling back towards the verandah but even making low hops in an evident attempt to rise in the air. I feel definite that some kind of message was interchanged. Or, was it merely an acute sense of smell that was responsible? After a few minutes the adults departed and the baby lay down at the gate as if dead. This new performance was repeated five times over by adults and baby, till on the fifth occasion one of the adults alighted near the baby and took it back to its home in the meter box. The time was then 8.40 p.m. Throughout the proceedings I did not hear a sound.

Officers' Quarter A-1,
Old Police Lines, *Lt. Col.* A. DAVID
Morigate Road,
Delhi-6,
*October* 3, 1967.

## 3. NOTES ON THE COMMON PALM CIVET OR TODDY CAT *PARADOXURUS HERMAPHRODITUS* (PALLAS), WITH SPECIAL REFERENCE TO THE AGE AT SHEDDING OF THE MILK TEETH

(*With two plates*)

On 12-viii-1965 a female kitten of *Paradoxurus hermaphroditus* (Pallas) was given to us by members of the priestly community in charge of the great temple here, Lingaraj or Bhubaneswar, in the compound of which they informed us that they had captured her on the previous day.

This kitten (Plate I, *above*) was completely weaned when received and was able to eat raw meat quickly and deftly. She has not become tame, perhaps because she was too old when captured. In 1966, thanks to Mr. Ghanashyam Naik, the Superintendent of the Nandan Kanan Biological Park near Bhubaneswar, we have examined young animals who were seen by him on recorded dates before their eyes were open. These comparisons make certain that our own animal, here discussed, was born not later than May 1965, and most probably during the previous February.

Examination of these Nandan Kanan kittens has also enabled us to confirm Pallas' original description of the male genitalia published in 1777 by Schreber in Vol. III of his SÄUGETHIERE. We are grateful to Professor Ernst Mayr for the following translation of this from the German.

'Above the penis extends a longish bare area toward the anus, the tender and white skin of which, below, where it begins, forms a double fold with an intervening cleft [Scheidung].

'This is the reason why uninformed people have been shown this animal as a hermaphrodite.'

In a six months' old individual the penis is actually in this bare area enclosed by the two folds and the testes have not descended into an external scrotum. The form and position of the vulva of our now adult female is unexceptional when compared with those of dogs and cats, though both orifices are horizontal and ventral when at rest.

After various experiments she is now fed on fruit, chiefly bananas, which are necessary to keep her stools firm. The divergence of the nostrils and the vertical cleft down the centre of the rhinarium of this civet parallel the nose structure of another banana eater, the fruit bat *Cynopterus sphinx* (Vahl). She also receives daily one raw egg and a helping of flesh, either mammal, fish, prawns or snails, supplemented by insects and the small vertebrates that our dog maims or kills, but does not eat herself. The only mammalian butcher's meats the civet will now accept

are raw goat's liver, and various preparations of cooked and salted pork. She accepts cakes and sweets, but not their raw materials such as *gur* or chopped coconut. Care has to be taken to vary what is offered to her, as she is the first non-human animal known to us who shows the human corruption of alternating periods of greed for a food substance, with periods of refusal to accept it.

She breaks an egg by steadying it with her forepaws and biting into it. Usually this steadying is performed by lifting the egg with paws several centimetres off the ground (Plate I, *below*), and gradually lowering it so that when the teeth penetrate the shell it is cupped between the pads of her paws, and the knuckles rest on the ground.

That insects are food may explain a peculiar reaction of which we publish two photographs. On both occasions on which she was first offered a new blanket of thick, rough, *eri* [*Philosamia cynthia* (Drury)] silk, she reacted as though she were afraid of it, withdrawal alternating with timid experimental bites dragging the blanket towards (Plate II, *above*) her, and then letting go to retreat from it (Plate II, *below*). The behaviour pattern resembled that exhibited by a dog to a mechanical toy, and may have a similar explanation. A dog in this context is interpreted as being frightened because the toy has movement like a living being, but is not alive.[1] It is possible that this raw silk even after spinning, weaving and some laundering still smelt significantly of insects, smells which certainly excite her, and for which, in captivity, she may be starved. Such a smell associated with a non-insect form might excite the fear reaction observed.

Prater (1965) states that civets are silent animals. Ours has produced no sound except a cat-like explosive spit when she fears she may be touched. This is often accompanied by a stamp. She hits the floor abruptly with one of her forepaws, thus making a sharp sound coincident with the vocalization and contributing to the effect.

On 23-v-66 it was noticed that her right lower canine was missing. While demonstrating this absence immediately afterwards, the left lower canine was seen to be leaning outwards in its socket, i.e., it too was working loose. On 24-v-66 both the empty sockets were seen, but on 27-v-66 she possessed two new lower canines already erupted sufficiently to show their characteristic shape, and for their crowns to extend above the level of the adjacent incisors and molars. No partial double row of teeth could be seen in the lower jaw, as can be seen in young cats when they are replacing their milk, or deciduous, dentition by their permanent dentition. Thus the milk canines were replaced by their permanent

[1] Since making the first draft of this note we have seen our dog react similarly ambivalently to a somewhat naturalistic scarecrow in a turban and pyjamas. Until this we have always believed that scarecrows were ineffectual, being based on inaccurate suppositions about animal behaviour.

Jayakar: Common Palm Civet

*Above* : ♀ born 1965—on 13-8-65
(*Photo : J. C. Hoard*)

*Below* : ♀ born 1965—eating egg on 16-1-66
(*Photo : S. D. Jayakar*)

*Above :* ♀ born 1965—15-1-66 timidly attacking a new silk blanket
*Below :* Two or three minutes later, apprehensively watching the same blanket (in the top right hand corner of picture) from a distance
(*Photos : S. D. Jayakar*)

representatives when this palm civet was 12 to 15 months old, and the eruption of the latter was explosive. This would seem appropriate to the way of life of a full grown herbivorous and insectivorous carnivore (Davis quoted by Dücker 1965). No other losses of teeth have been noted, but we were away from Bhubaneswar between 20/vi and 13/vii, 1966. As is usual after such an absence, changes were found to be conspicuous, and the dentition of her lower jaw (which, in the cage provided, is seen more frequently and easily than that of the upper) had become more robust and the teeth more differentiated. Therefore we conclude that tooth replacement had continued.

We have seen only a fraction of the relevant literature on this group but neither Ewer (1963) nor Dücker (1965), both of whom bred viverrids in conditions of intimacy, give any information about tooth replacement. Information on this in any species seems rare. Mivart (1881) writing of the milk teeth of the domestic cat says, 'They begin to fall out after the seventh month, but the lower true molar comes into its place before the deciduous molars fall out'. Sisson & Grossman (1953) state that the process in domestic dogs begins when they are between four and five months old, the canines being among the earliest to be replaced.

When dogs and cats are similar, as in this, in their gestation periods, and their expectations of life there is a tendency to assume that they are typical of the smaller fissipede carnivores. However Maxwell (1960) quotes the first owner of one of his otters as stating that she replaced her milk teeth by her permanent teeth coincidentally with weaning, and they estimated this to be at not more than 3 months old. In a later book Maxwell (1963) identifies this individual as belonging to *Lutra cornuta*, but as this west African species is clawless, and a male grew to a weight in the region of 50 lbs. some authorities might prefer to change the generic designation.

Crandall (1965) gives 14 years 5 months 12 days as the record for *P. hermaphroditus* in captivity, and quotes Simon (1943) that a European otter lived for over 22 years in the Trivandrum Zoo. Thus both species might in this respect be expected to have an expectation of life in captivity similar to dogs and cats.

We would be interested in any other records of ages at the eruption of permanent dentitions in small carnivores. This, after all, constitutes a climacteric in the development of a mammal.

GENETICS AND BIOMETRY LABORATORY, S. D. JAYAKAR
GOVERNMENT OF ORISSA, H. SPURWAY
BHUBANESWAR-3,
ORISSA, INDIA.
*December*, 1966.

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## 4. NOTES ON THE MALABAR SPINY DORMOUSE, *PLATACANTHOMYS LASIURUS* BLYTH, 1859, WITH NEW DISTRIBUTION RECORD

During the course of routine trapping of small mammals in the Kyasanur Forest Disease (KFD) area in Shimoga District, Mysore State, one female Spiny Dormouse was captured on February 2, 1966, from Dasangadde, near Sagar in Shimoga District (Altitude 1800 Ft.; Latitude 14° 10′). The identification was confirmed by Mr J. C. Daniel of Bombay Natural History Society. Subsequently another specimen, also a female, was captured from the same locality on 21 May 1966. The external measurements in millimetres of these two specimens were:

| | | |
|---|---|---|
| Head and body .. | 155 | 140 |
| Tail .. .. | 85 | 80 |
| Left hind paw .. | 25 | 23 |
| Left ear .. .. | 17 | 17 |

Ellerman & Morrison-Scott (1951) and Ellerman (1961) have reported this species from 'Coorg, Travancore and Malabar in Southern Peninsular India'. Shortridge (in Ryley 1913), says that '*Platacanthomys* is known to exist as far north as Kadur District in Western Mysore'. The finding of this species near Sagar extends the northern limits of the distribution of this species in India.

Both the specimens were trapped in Sherman traps (9″×3″×3½″) using 'Pakoda' as bait (a mixture of onion and gram flour fried in oil). During the extensive and intense trapping of small mammals over the past ten years in a variety of habitats, this specimen was recorded only twice in the KFD area, and as such the species should be considered rare in this area.

The description of this species tallies with Ellerman's (1961) description except in two respects. The colour of the back is not 'dark reddish brown'. There is no reddish tinge to the coloration at all. Also

the spine-like hairs are white tipped, a fact not stated in the FAUNA OF INDIA volume, but mentioned by Shortridge (loc. cit.)

It is quite probable that this species feeds on ripe pepper (*Piper nigrum*) and Jackfruit (*Artocarpus* sp.) which abound in the forests of Sagar area. In captivity, one female is thriving very well on a feed of bananas and groundnut for the last twenty months. During the day the animal is sluggish and has a tendency to curl up like a hedgehog, with the bushy tail protruding. The animal is active during the night only and feeds voraciously. It is very shy and tries to hide in some corner when approached and is quite tame to handle.

VIRUS RESEARCH CENTRE,[1]
POONA,
*December* 4, 1967.

P. K. RAJAGOPALAN

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## 5. OCCURRENCE OF THE REEF HERON [*EGRETTA GULARIS* (BOSC.)] IN HYDERABAD DISTRICT

On the afternoon of June 8, 1967, I observed a slate-blue wading bird feeding at the edge of the Shamsabad (A.P.) tank in the company of 18 little egrets [*Egretta garzetta* (Linnaeus)].

It appeared to be almost exactly the same size as the egrets, and when the flock flew up, it displayed the same manner of flight, with head pulled in and legs trailing behind.

Closer examination—I was able to approach to within perhaps 40 feet—revealed the bird quite positively to be an Indian Reef Heron [*Egretta gularis* (Bosc.)], with a conspicuous white patch on its throat and bright yellow feet which flashed into prominence once when it flew directly away from me. I cannot be positive as to the colour of its legs and bill.

When I returned to the tank on the afternoon of June 17, 1967, the reef heron was still there again feeding at water's edge with several little egrets.

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[1] The Virus Research Centre is jointly maintained by the Indian Council of Medical Research and The Rockefeller Foundation. The Centre also receives a grant (3 × 4307) of the PL 480 Funds from the National Institutes of Health, US PHS, through the Indian Council of Medical Research.

I observed the bird for perhaps two hours altogether, in conditions of both full sunlight and overcast skies.

The south-west monsoon (light showers) arrived on June 7 in this area (Hyderabad Dist.), but I cannot say whether this may have had some influence in the occurrence of this western sea-coast bird so far inland.

SHAMSABAD,
HYDERABAD DISTRICT,
ANDHRA PRADESH,
*July* 8, 1967.

GEORGE F. NEAVOLL

## 6. THE FEMALE OF MOLESWORTH'S TRAGOPAN *TRAGOPAN BLYTHI MOLESWORTHI* BAKER

(*With a plate*)

Molesworth's Tragopan, *Tragopan blythi molesworthi* Baker, has so far been known from only two specimens, both males. The holotype was taken by Capt. A. L. M. Molesworth at Dengan La (alt. *c.* 2438 m.), *c.* 27° 11′ N. 92° 1′ E., Scherechopka country, south-eastern Bhutan, on 31 March 1914. Ludlow (1944)[1] procured the second specimen from Shingkar (alt. *c.* 2591 m.), Louri District, eastern Bhutan (*c.* 64 km. north-west of Dengan La, the type-locality), on 1 April 1936. Its female has so far been unknown.

During a recent ornithological survey of Bhutan undertaken jointly with Dr. Sálim Ali since 1966, I have been able to collect a female Tragopan which clearly belongs to *Tragopan blythi*, but differs from the nominate subspecies in some important details. There can, therefore, be little doubt that my specimen represents *T. b. molesworthi*, and the first known female at that (Plate).

The specimen was taken by me above the Bulfai Pass (alt. *c.* 2621 m.), *c.* 27° 14′ N. 91° 31′ E., Manas Valley, eastern Bhutan, on 30 March 1966. It was shot while skulking in a patch of rhododendron forest with thick undergrowth of various herbs and shrubs, and a few scattered clumps of ringal bamboo. It was a lone example busily feeding at about 8.00 hours when my presence there disturbed it.

This female specimen differs from the females of the nominate subspecies in having the whole upper plumage darker, the blackish marks being larger and deeper coloured, grey-brown markings much deeper grey and less brown, ear coverts subtipped rufous, rufous-centred cheek-

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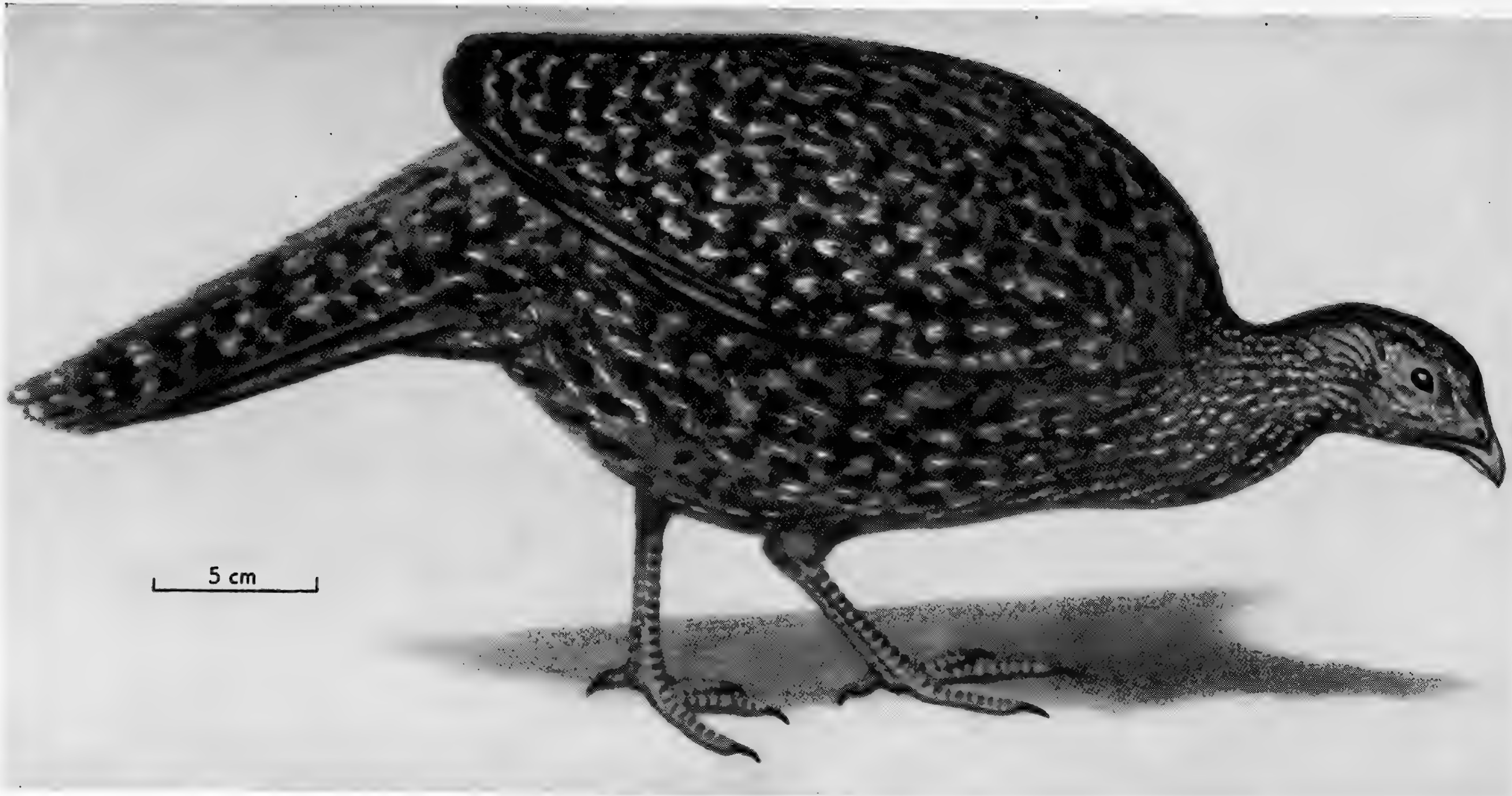
[1] LUDLOW, F. (1944): The birds of south-eastern Tibet. *Ibis* **86**: 380-381.




Molesworth's Tragopan (*Tragopan blythi molesworthi* Baker). Female.

feathers, rump and upper tail coverts greyer and not quite so reddish in general tone. On the underside, the rufous edges of feathers of breast and abdomen deeper.

COLOUR OF SOFT PARTS : Iris dark brown, edges of eyelids lemon yellow, maxilla black but brown on base, mandible very pale horny, legs and feet brownish horny, claws horny, pads white.

MEASUREMENTS (in flesh) : Wing 232, tail 155+, bill 33 mm.

Its crop contained no animal matter, but was distended with freshly swallowed plant material. The bulk of this food consisted of green leaves of *Spiraea* sp. (Rosaceae), *Herpetospermum caudigerum* (Cucurbitaceae) and young circinate leaves of fern of the Order Filicales in approximately equal quantities, moderate quantity of green leaves of *Thalictrum chelidonii* (Ranunculaceae), and a few fronds of fern of the Order Filicales. Most of the leaves were swallowed whole or nearly so, and two of the fern fronds were about 9·5 cm. long. There was also a quantity of leaf fragments, bits of tender shoots, petioles and leafbuds, all apparently belonging to plants named above.

I am thankful to the authorities of the British Museum (Natural History), London, for their courtesy in extending me facilities to examine their material. I am indebted to; Mr. J. Delacour for kindly comparing my specimen with the material at the American Museum of Natural History, New York; Shri S. S. Saha of the Zoological Survey of India for his generous assistance in this work; Shri V. S. Agarwal of the Botanical Survey of India for kindly identifying the plant material; and to Shri A. K. Karmakar, Artist, Zoological Survey of India, for the preparation of the coloured sketch.

ZOOLOGICAL SURVEY OF INDIA,
INDIAN MUSEUM,
CALCUTTA-13,
*September* 18, 1967.

BISWAMOY BISWAS

## 7. OCCURRENCE OF THE LITTLE CRAKE, *PORZANA PARVA* (SCOPOLI), IN BOMBAY

In 1939 (Birds of Bombay Island & Salsette, *J. Bombay nat. Hist. Soc.* **40** : 629), we referred to the Little Crake, *Porzana parva* (Scopoli), as an aberrant cold weather straggler to our area based on a specimen obtained at Malabar Hill, Bombay, by A. H. A. Simcox.

We mentioned however that the specimen listed in the old card catalogue of the Society's collection prepared by Mr. N. B. Kinnear had not been seen (presumably being untraceable).

It was probably this uncertainty which prompted Ripley (1961)[1] to ignore this southern-most record and to restrict them to 'A few wintering records for West Pakistan in Sind and Baluchistan, and Gilgit'.

The specimen (B.N.H.S. Col. No. 13878, ♀, 27 Nov. 1914) has now been rediscovered, having been listed among Baillon's Crake, *Porzana pusilla* (Pallas). It is admittedly very similar to this species but the larger wing 98 (85-96 in *P. pusilla*), the absence of the white edge to the first primary and to the tips of the wing coverts, the buff-coloured breast and under-parts, the faint traces of black barring on the flanks and under-tail coverts, the structure of the wing, and comparison with specimens from Iraq, leave no doubt that the bird was correctly identified.

BOMBAY NATURAL HISTORY SOCIETY,
HORNBILL HOUSE, APOLLO STREET,
BOMBAY-1,
*September* 27, 1967.

SÂLIM ALI
HUMAYUN ABDULALI

## 8. SOUTHWARD EXTENSION OF THE RANGE OF THE SLENDERBILLED GULL (*LARUS GENEI* BRÊME)

The Slenderbilled Gull (*Larus genei* Brème) is known to breed at Las Belas in Baluchistan and in parts of Sind, and as a non-breeding visitor to the shores and tidal creeks of Sind. The southern-most records are from Bhavnagar in Kathiawar where Dharmakumarsinhji obtained a specimen on 4 December 1948 (BNHS Collection No. 14176) and referred to it in his BIRDS OF SAURASHTRA (1955 p. 213). Dr. Sâlim Ali does not mention this bird in BIRDS OF KUTCH (1945) nor 'The Birds of Gujarat' (1954, *J. Bombay nat. Hist. Soc.* **52**: 375), and Ripley's SYNOPSIS leaves the first distribution unchanged.

It may therefore be worthwhile recording that on 4 December, 1957, I collected one (BNHS Collection No. 21330) in Manori Creek, Salsette, Bombay, and have subsequently seen them in small parties and obtained specimens on 28 December 1960 and 9 January 1964, in the same area (Manori and Arnala Island). It would appear to be a fairly regular winter visitor to the Bombay coast. It is perhaps not better known because, not being a scavenger like the other gulls, it keeps out more at sea. The 3 specimens obtained by me and also the one from Bhavnagar are all in immature plumage, having dark subterminal bands to the tail.

ST. XAVIER'S HIGH SCHOOL,
BOMBAY,
*May* 6, 1967.

BR. A. NAVARRO, S.J.

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[1] RIPLEY, S. D. (1961) : Synopsis of the Birds of India and Pakistan.

## 9. SAP SUCKING BY INDIAN WOODPECKERS

(*With a photograph*)

Readers will be interested to see the accompanying photograph of an apple tree (*Pyrus malus*) in the middle of a lawn, taken at the Chasme Shahi Gardens in Srinagar (5000 feet), Kashmir, on 21 July 1967. The lines of dark spots represent small holes dug into the bark in rings round the stem at regular intervals of a few inches along the whole height.

The first impression was that this was the work of an idle schoolboy, but this was dismissed in consideration of the magnitude of the work, its commencement at almost ground level, and its extension far out of his reach. We were discussing the possibility of its being a woodpecker, when a gardener joined in and confirmed our suspicions. I had a vague recollection of having seen a photograph of such holes and the name of the American Sapsucker was suggestive, but I could not recall any reference to sap-sucking in India. The HANDBOOK OF BRITISH BIRDS

(1938, **2** : 277 and 285) refers to rare instances in Britain of *Picus viridis* (doubtfully) and *Dryobates major* (certainly) ringing trees with series of regularly-spaced pits after the fashion of the American Sapsuckers (*Sphyrapicus*). In Indian literature I have only been able to find A. E. Osmaston's note ' Curious habits of Woodpeckers in the Kumaon Hills ' (1916, *J. Bombay nat. Hist. Soc.* **24** : 363-366). As this would not be easily accessible to most members, I reproduce portions of it :

' Those who know the hill forests of Garhwal may have noticed at one time or another rows of small neat holes made in lines across the stems of trees. They may be seen at any height up to at least 30 feet from the ground and the rows are nearly always quite horizontal. Each row consists of perhaps a dozen holes, half an inch or so apart, and the rows may be any distance down to a few inches one above the other. Often the distance apart is repeated with remarkable accuracy and in this case the rows are not separated as a rule by more than 6 to 8 inches. The holes themselves are more or less rounded and about $\frac{1}{4}$ to $\frac{1}{3}$ inch across in section and they invariably pierce through the bark to atleast half its thickness, but never in any circumstances enter the woody tissue beneath.

For the last few years I have been endeavouring to discover what it is that forms these holes and why they are formed. A general answer to the first question is fairly easily given.

The holes are undoubtedly formed by woodpeckers. The species of woodpecker responsible for this work of art and what this objective may be are questions not so easily disposed of.

If these holes be examined it will be found that they only occasionally show signs of recent attack. In by far the majority of cases the holes have been made some months or years previously and do not show any obvious signs of having been tampered with since. Such holes may extend only half way through the bark, but more frequently they extend right down to the delicate cambium layer separating the cortical from the woody tissue. Again, some of them will be found empty whilst others will contain a core of secondary growth tissue which may have completely filled up the lower half of the original cavity. This tissue is usually soft and spongy and sometimes tinged green. Where no such core of secondary tissue is present the bottom of the hole may contain a soft fungal growth which is usually white.

In some cases, however, the holes show signs of a recent visit. This is recognised by evidence of a fresh incision into the secondary growth tissue at the base of the cavity.'

Osmaston goes on to list separately the trees most frequently (including *Pyrus pashia*) and occasionally attacked such trees being found between 6000 ft. and 10,000 ft. but usually between 6500 ft. and 7500 ft. He had no evidence that any of the eight possible species of woodpeckers

listed by Blanford makes the holes or that any other does not. He notes that the Rufousbellied Pied Woodpecker *Hypopicus hyperythrus* (which, incidentally, Ripley calls a sapsucker in the SYNOPSIS) systematically visits such holes and suggests that this is one, if not the sole, perpetrator. When concluding, Osmaston suggests that the holes are made horizontally (he does not refer to rings round the stem?) merely because the bird finds it more convenient to work sideways rather than upwards or downwards.

My first impression also was that the boring was for insects, but I am inclined to think that the distance between the rows is an index of the size of the bird—each row serving as a foothold for working on the next. The bark of the apple trees on which I found this pitting was smooth, unlike the rough bark on which woodpeckers usually hunt for insect food. The possibility that strikes me is, therefore, that the woodpecker starts the pecking at a level where some foothold is available and then works upwards using each ring of pits as a foothold for making the next ring. Osmaston's suggestion about *H. hyperythrus* being the maker of such pits is strengthened by its having a brush-like tip to its tongue, but as regards the locality in which I noticed the pitting I do not know if this species could have been responsible as it is not mentioned for this area in Bates & Lowther's BREEDING BIRDS OF KASHMIR (1952), the woodpeckers listed being *Picus squamatus*, *Dryobates himalayensis* and *Dryobates brunneifrons*, the last of which I noticed in the neighbourhood.

75, ABDUL REHMAN STREET,
BOMBAY-3,
*October* 11, 1967.

HUMAYUN ABDULALI

## 10. OCCURRENCE OF THE HOUSE MARTIN, *DELICHON URBICA* (LINN). IN SAURASHTRA, GUJARAT

On 3 April 1967, Y. S. Shivrajkumar of Jasdan and myself were walking in the evening on the dam of the Jasdan tank when we saw quite clearly the House Martin (*Delichon urbica*), a single bird, hawking with swallows, crag martins, and swifts. The House Martin had a forked tail and was easily recognizable by the long white patch on the rump and upper tail coverts and also its pied head pattern. We looked up 'Birds of Gujarat' by Sâlim Ali (1954)[1] in which he mentions this bird

[1] *J. Bombay nat. Hist. Soc.* **52** : 375.

at Navsari. Our sighting of the House Martin must be the second record for its occurrence in Gujarat.

DIL BAHAR,
BHAVNAGAR,
*April* 12, 1967.

R. S. DHARMAKUMARSINHJI

[This is a rare and sporadic winter visitor from the Himalayas, chiefly on the western side of the Peninsula. In addition to Gujarat, as above, has been recorded from Maharashtra (Prakasha on Tapti R., W. Khandesh; Sinhgadh near Poona), Madhya Pradesh (Sehore), Mysore (Haliyal near Londa; Belgaum; Shimoga), Madras (Coimbatore; Nilgiris, between Ootacamund and Coonoor), and there is a specimen labelled 'Travancore' in the British Museum collection. Apparently the eastern-most record is from Bilaspur, *c.* 22°N., 82°E.—Eds.]

## 11. WIRE NESTS OF REDVENTED BULBUL *PYCNONOTUS CAFER* (LINNAEUS)

On 14 October 1967, I came across three nests of Redvented Bulbul, *Pycnonotus cafer* (Linnaeus) with 10-15 day old fledglings, in the Hadapsar Industrial Estate at Poona. Two of these nests which were located in the large compound of a factory manufacturing electric motors and fans etc. were partially constructed out of fine copper wire (S.W.G. 34) generally used for winding of rotor and field coil of stator of electric motors. Almost 50% of the nest lining of these nests was done with this wire, which had apparently been picked from the heaps of discarded wire pieces in the compound.

So far only House Crows (Hume 1889 : 9 ; Baker 1932 : 16 ; Dewar 1929 : 27-28 ; Lamba 1963 : 125) and Doves (Walsh 1924 : 1055-1056) have been recorded to incorporate metallic wires and strips in the nest structure. The belief (Lamba 1967 : 154) that these unusual materials are used as an easily available substitute for the normal nesting materials and comparative scarcity of the same in the nesting area is amply strengthened by this find.

WESTERN REGIONAL STATION,
1182/2, F.C. ROAD,
POONA-5,
*October* 17, 1967.

B. S. LAMBA

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## 12. *CETTIA MONTANA* VERSUS *C. FORTIPES* (AVES: SYLVIINAE)

In Vol. **60**: 683, Dec. 1963 of this *Journal*, Biswas advocates changing the name *Cettia fortipes* to *C. montana* on grounds of priority. Ripley, in his supplement immediately following (p. 687-689), does not mention the point. It would thus appear that neither of these authors, nor the several others consulted by Biswas, is familiar with the facts in this case.

Earlier, Delacour had also used *montana* in a revision of *Cettia* in 1943. I, and doubtless others, called his attention early in 1946 to the fact that it is preoccupied; he published a correction (*Auk* **64**: 129, 1947), unfortunately without giving a bibliographic citation of the rather obscure first publication of the name.

The fact is that the name *Sylvia montana* Horsfield, 1821, given to a *Cettia*, is a homonym of the little-known *Sylvia montana* Wilson, 1812 (American Ornithology **5**: 113, pl. 44, fig. 2). It is thus still-born and can never be revived, even though Wilson's bird has never been satisfactorily identified. It has been considered a doubtful synonym of *Dendroica virens* (Gmelin) by Ridgway (*United States National Mus. Bull.* **50**, part 2: 784, 1902), or a 'lost species' of Wood Warbler (Parulidae). In view of Wilson's care and accuracy, and of the strange hybrids and freaks in this family of birds that have recently been captured, it is not unthinkable that Wilson may have drawn certain of his plates from abnormal specimens or hybrids.

Be this as it may, the name *Cettia fortipes* (Hodgson), 1845, should stand, and the changes suggested by Biswas (loc. cit.) should not be made.

Another of Biswas' points (loc. cit., lines 13-12 from bottom) is not invariably correct. The type locality of a form is not automatically 'the place of origin of the first specimen (type)'. If an author has specimens from various places, all are equivalent cotypes unless his description or comments eliminate some from consideration as cotypes, or unless he *designates* one or more types. Biswas is correct, however, that the

locality of a mere sighting is ineligible, except in those rare cases where a species is described with no specimen in hand.

Apartado Postal 19-138,
Mexico 19, D.F.,
Mexico,
*July* 1967.

ALLAN R. PHILLIPS

Dr. Biswas whose comments were invited writes :

When the homonymy between *Sylvia montana* Wilson, 1812, and *Sylvia montana* Horsfield, 1821, was discovered both nominal species had been transferred to different genera and there was no danger of confusion since at the time of discovery of the potential homonymy the two species are no longer included in same genus.

In his revision, Delacour (*Ibis* **85** : 27-29, 1943) used the name *Cettia fortipes* for the species and *montana* as the subspecific name of the Javan population. I have not seen Delacour's correction referred to, but apparently he did not think much about it, for in 1949, while giving me a copy of his *Cettia* paper, he himself changed *fortipes* to *montana* as the specific name (on p. 27 of the paper) and told me that *montana* was older. And, I find that even in the recent comprehensive work of Vaurie (BIRDS OF THE PALEARCTIC FAUNA : Passeriformes, pp. 223- 224, 1959), *Cettia montana* Horsfield has been retained. Ripley verbally informed me that he followed Delacour's paper in using the name *Cettia fortipes* for the species.

Regarding the second point, that is, about type-locality, my point is indeed invariably correct, for the place of origin of ' the type ' (=type specimen=holotype) must necessarily be its type-locality. What Dr. Phillips says is also correct, but only in regard to syntypes from different localities, which does not arise here, for all the ' first specimens ' (=syntypes) of *Graminicola bengalensis* were taken in Cachar.

B. BISWAS

[We might add that in a subsequent letter Dr. Phillips draws attention to Vaurie's using the name *Cettia montanus* in his BIRDS OF THE PALEARCTIC FAUNA and ' It now occurs to me that, by failing to mention Vaurie, I perhaps implied that the oversight was original with Biswas rather than general '—Eds.]

## 13. SOME BIRD RECORDS FROM KUTCH

This morning while driving along a *kuchha* motor road outside Vijaya Vilas Palace, I saw and shot from a little pond a Sheld-duck [*Tadorna tadorna* (Linnaeus)]. As you will observe the only specimen mentioned in the BIRDS OF KUTCH was obtained by Col. C. B. O'Brien who evidently shot it at a tank near Bhachau in 1921. So this is the second specimen obtained in Kutch so far. Both the bill and the legs were pale pink. Therefore, I presume, it was a female.

The other bird I noticed in the compound of Sarad Bagh Palace, Bhuj, on November 25, was the male of the Paradise Flycatcher *Terpsiphone paradisi* (Linnaeus). It tallied with the description given on page 162 of the BIRDS OF KUTCH.

PALACE,
BHUJ (KUTCH), MAHARAO OF KUTCH
*December* 4, 1966.

## 14. SOME INTERESTING MIGRANTS IN KUTCH

On December 11, 1966, I went up to the Laeja Creek, 8 miles west of Mandvi, to watch the waders and in the middle of the creek I saw a solitary Indian Skimmer (*Rhynchops albicollis* Swainson). I have seen this bird only once before in August 1947 in the same place (1956, *J. Bombay nat. Hist. Soc.* **54** : 190).

In addition to the Paradise Flycatcher [*Terpsiphone paradisi* (Linnaeus)] seen by H. H. Maharao Saheb in the Sarad Bagh garden in Bhuj last November, I saw one in Mandvi on December 10, (also male). Although this bird is rare in Kutch I have seen it on many occasions, mostly in the Vijaya Vilas Palace grounds at Mandvi.

The other rare visitor seen by me on December 18, was the White-browed Fantail Flycatcher (*Rhipidura aureola* Lesson) at Vijaya Vilas. I have seen this flycatcher only once before in Rapar (Rav).

This year also I was lucky enough to add one more bird to the Kutch list. On January 10, I came across the Forest Wagtail (*Motacilla indica* Gmelin) in my own compound at Bhuj. Only one bird was observed by me which seems to have taken up its residence in my garden here, for I saw the bird again today. This bird is not at all shy and allows a very close approach. Though very like the other wagtails in its general appearance, unlike the others, which move their tails vertically, this one moves it horizontally and with this movement of the tail its whole body also appears to sway gracefully.

BHUJ,
KUTCH, M. K. HIMMATSINHJI
*January* 16, 1967.

## 15. RECOVERY OF RINGED BIRDS

| Ring No. and Species | Date and place of ringing | Date and place of recovery | Remarks |
|---|---|---|---|
| C-1471 *Anas crecca* ♂ | 10.10.1966. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) | + 30.4.1967. Altaisk Region near Kuchuk (53° 30′ N., 82° 26′ E.) | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| C-1580 *Anas crecca* ♂ | 12.10.1966. do. | + 19.3.1967. Tadjik S.S.R., near Dushanbe (38° 35′ N., 68° 47′ E.) | do. |
| C-2585 *Anas crecca* ♂ | 19.10.1966. do. | 26.3.1967. Kirghizian S.S.R., near Suzak (40° 57′ N., 72° 55′ E.) | do. |
| C-342 *Anas crecca* ♂ | 6.2.1964. Manjhaul, Monghyr Dist., Bihar (*c.* 25° 23′ N., 86° 30′ E.) | + 12.5.1967. Yakutian A.S.S.R., Aldan Dist., near Chulman (*c.* 56° 50′ N., 124° 53′ E.) | do. |
| C-1366 *Anas crecca* ♂ | 8.10.1966. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) | + 18.3.1967. Kazakh S.S.R., Dzhambul Region, near Furmanovka (*c.* 44° 18′ N., 72° 55′ E.) | do. |
| C-1466 *Anas crecca* ♂ | 10.10.1966. do. | + 8.4.1967. Uralsk Region, near Uralsk. (*c.* 51° 17′ N., 51° 23′ E.) | do. |
| C-2526 *Anas crecca* ♀ (?) | 15.10.1966. do. | + 26.3.1967. Alma Atinsk Region, near Sarkand (*c.* 45° 24′ N., 79° 58′ E.) | do. |
| C-2563 *Anas crecca* o ? | 18.10.1966. do. | + 18.3.1967. Dzhambul Region, about 150 km. north from the town of Dzhambul | do. |
| C-2607 *Anas crecca* ♂ | 19.10.1966. do. | + 8.5.1967. Sverdlovsk Region, near Taborg (*c.* 58° 31′ N., 64° 36′ E.) | do. |
| C-2658 *Anas crecca* ♂ | 19.10.1966. do. | + 22.4.1967. Kustanaisk Region, near Uritskoe (*c.* 53° 20′ N., 65° 30′ E.) | do. |
| C-2692 *Anas crecca* ♀ | 20.10.1966. do. | + 30.4.1967. Altaisk Region, near Melnikovo (*c.* 52° 13′ N., 81° 24′ E.) | do. |
| C-2848 *Anas crecca* ♂ | 23.10.1966. do. | + 4.5.1967. Kurgan Region, near Yautla (*c.* 56° 40′ N., 64° 26′ E.) | do. |
| C-2849 *Anas crecca* ♂ | 23.10.1966 do. | + 7.5.1967. Tomsk Region, near Molchanovo (*c.* 57° 35′ N., 83° 51′ E.) | do. |
| C-2852 *Anas crecca* ♂ | 23.10.1966. do. | + 7.5.1967. Krasnoyarsk Region, near Achinsk (*c.* 56° 17′ N., 90° 30′ E.) | do. |

## RECOVERY OF RINGED BIRDS—(*contd.*)

| Ring No. and Species | Date and place of ringing | Date and place of recovery | Remarks |
|---|---|---|---|
| C-2853 *Anas crecca* ♂ | 23.10.1966. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) | + 11.4.1967. Kirghizian S.S.R., Osh Region, near Gulcha (*c.* 40° 19′ N., 73° 28′ E.) | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| C-2913 *Anas crecca* o? | 24.10.1966. do. | + 6.3.1967. Dzhambul Region, near Mikhailovka (*c.* 43° 00′ N., 71° 37′ E.) | do. |
| C-2983 *Anas crecca* ♂ | 19.1.1967. Naopara, Chilka Lake (*c.* 19° 28′ & 19° 56′ N., 85° 86′ E.) | + 7.5.1967. Near Krasnoyarsk (*c.* 56° 00′ N., 92° 52′ E.) | do. |
| C-2522 *Anas crecca* ♂ | 15.10.1966. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) | + 22.4.1967. Karagandinsk Region, near Kievka (50° 18′ N., 71° 33′ E.) | do. |
| C-2646 *Anas crecca* ♂ | 19.10.1966. do. | + 5.5.1967. Novosibirsk Region | do. |
| C-2711 *Anas crecca* ♂ (juv.) | 20.10.1966. do. | + 3.6.1967. Tyumen Region, near Tarkosale (64° 47′ N., 77° 40′ E.) | do. |
| C-2984 *Anas crecca* ♀ (?) | 19.1.1967. Naopara, Chilka Lake (*c.* 19° 28′ & 19° 56′ N., 85° 86′ E.) | + 5.5.1967. Krasnoyarsk Region, near Shushenskoe (53° 20′ N., 91° 55′ E.) | do. |
| C-339 *Anas crecca* ♂ | 6.2.1964. Manjhaul, Monghyr Dist., Bihar (*c.* 25° 23′ N., 86° 30′ E.) | 7.5.1967. Altai Region, near Rubcovsk (51° 30′ N., 81° 11′ E.) | do. |
| C-1352 *Anas crecca* ♂ | 6.10.1966. Bharatpur | 18.9.1967. Grkutsk Region near Kazachinskoe (56° 17′ N., 107° 35′ E.) | do. |
| C-2623 *Anas crecca* ♂ | 19.10.1966. do. | + 5.9.1967. Semipalatinsk Region, Ayaguz District, Sasyk-kul'-Lake (46° 14′ N., 81° 00′ E.) | do. |
| C-2666 *Anas crecca* ♂ | 19.10.1966. do. | + 21.4.1967. Karaganda Region (*c.* 50° 51′ N., 70° 72′ E.) | do. |
| C-2938 *Anas crecca* ♀ | 25.10.1966. Bharatpur | 29.9.1967. Altai Region near Altaiskoe (51° 57′ N., 85° 21′ E.) | do. |
| C-119 *Anas crecca* ♀ | 18.2.1964. Manjhaul, Monghyr Dist., Bihar (*c.* 25° 23′ N., 86° 30′ E.) | 0.8.1967. Irkutsk Region near Nizhnjaja Karelima (57° 58′ N., 107° 51′ E.) | do. |

RECOVERY OF RINGED BIRDS (*contd.*)

| Ring No. and Species | Date and place of ringing | Date and place of recovery | Remarks |
|---|---|---|---|
| C-427 *Anas crecca* ♂ | 28.11.1964. do. | 4.3.1967. Andizhan Region near Andizhan (40° 48′ N., 72° 22′ E.) | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| C-2534 *Anas crecca* ♀ (?) | 15.10.1966. Bharatpur | 29.9.1967. Karagandisk Region near Abai Karabas (49° 30′ N., 72° 48′ E.) | do. |
| C-2600 *Anas crecca* ♂ | 19.10.1966. do. | 23.9.1967. Tselinograd Region, Tselinograd Dist., Aizegul Lake (50° 22′ N., 71° 18′ E.) | do. |
| C-2643 *Anas crecca* ♀ (?) | 19.10.1966. do. | 0.9.1967. Karagandinsk near Karabas (49° 30′ N., 72° 48′ E.) | do. |
| C-2656 *Anas crecca* ♀ (?) | 19.10.1966. do. | 5.9.1967. Novosibrisk Region | do. |
| C-2787 *Anas crecca* ♂ | 22.10.1966. do. | 0.9.1967. Kurgan Region near Petukhoro (55° 03′ N., 67° 30′ E.) | do. |
| C-2928 *Anas crecca* ♀ (?) | 25.10.1966. do. | 29.9.1967. Alma-Ata Region near Aksu (45° 39′ N., 79° 30′ E.) | do. |
| C-3600 *Anas crecca* ♂ | 5.11.1967. do. | 16.12.1967 Sitapur Dist., U.P., 30 miles from Lucknow | Reported by Mr Chandra Bhan Singh, Sitapur |
| C-2829 *Anas crecca* ♀ (?) | 20.10.1966. do. | 20.12.1967. Gangiri, Aligarh (*c.* 27° 29′ N., 77° 29′ E.) | Reported by Rajendra Behari Lal Sharma |

BOMBAY NATURAL HISTORY SOCIETY,
HORNBILL HOUSE,
BOMBAY-1,
*January* 25, 1968.

EDITORS

## 16. NOTES ON TWO SPECIES OF *HEMIDACTYLUS* (GEKKONIDAE : REPTILIA) IN BHUBANESWAR

The observations described below were made in Bhubaneswar, Orissa. One of the two common domestic species in the new town of Bhubaneswar is *Hemidactylus brooki*. The other is almost certainly *H. leschenaulti*. In our house, the latter species seems the commoner by far, but this may be due to the fact that *H. brooki* is more shy. The numbers of ' groups ' of eggs found of the two species are the same ; however, the number of eggs found of *H. leschenaulti* are almost twice as many as for *H. brooki*.

### Oviposition

Twelve ' groups ' of eggs were found from 1964-66, 11 in our house and 1 in the laboratory, situated in the Agricultural College. A ' group ' of eggs consists of those found simultaneously at the same spot. All the eggs were found in dark places, most commonly in drawers and sometimes in distribution boxes of electrical connections. Eggs of *H. brooki* were found between April 9 and August 29 ; those of *H. leschenaulti* between April 4 and July 7. (Most copulations were observed in the month of May). Table 1 gives the dates of collection and hatching of the eggs. It is clear that eggs hatch in pairs. This suggests that they are laid in pairs as has been stated previously as a generalisation about geckos (Goin & Goin 1962, p. 268). What is striking is that the periods between the pairs of hatches is fairly constant for *H. leschenaulti*, varying from 9 to 13 days. The only similar period obtained for *H. brooki* was 29 days. In *H. leschenaulti* therefore, it would seem reasonable to infer that the eggs of one group are laid by a single female who returned to the same laying place as successive pairs of eggs became ready to be laid.

This observation does not seem to be generally known. Smith (1935, p. 27) for instance, suggests that groups of eggs found together are the layings of several different females. The above data make this interpretation unlikely. The period between consecutive layings of a female *H. leschenaulti* would seem to be about 11 days in this population. There are not enough data to provide similar evidence for *H. brooki*. However, if in the latter species also a female returns regularly to the same place for laying, the interval between consecutive layings is probably considerably longer in *H. brooki*. This I infer from the much longer periods recorded between collection of eggs and the first hatch in *H. brooki* (average 26 days) compared with those for *H. leschenaulti* (average 11 days). The average number of eggs per group is 2·3 for *H. brooki* and 4·0 for *H. leschenaulti*. The bigger average for *H. lesche-*

TABLE 1

DATA ON HATCHING OF EGGS

| | Group | Date collected | No. of eggs | Hatches | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | First set | | Second set | | Third set | |
| *H. brooki* | 1 | 9/4/64 | 1 | 6/5 | (27) | | | | |
| | 4 | 23/8/64 | 4 | 27/8 ; 29/8 | (4) | 25/9 | [29] | | |
| | 5 | 25/4/65 | 2 | 16/5 ; 16/5 | (21) | | | | |
| | 8 | 9/7/65 | 4 | 3/8 | (25) | | | | |
| | 9 | 13/7/65 | 1 | 21/8 | (39) | | | | |
| | 10 | 29/8/65 | 2 | 6/10 ; 6/10 | (38) | | | | |
| *H. leschenaulti* | | | | | | | | | |
| | 2 | 23/5/64 | 1 | 30/5 | (7) | | | | |
| | 3 | 28/6/64 | 7 | 5/7 ; 5/7 | (7) | 16/7 ; 16/7 | [11] | 29/7 ; 30/7 | [13] |
| | 6 | 7/7/65 | 2 | 27/7 | (20) | | | | |
| | 7 | 8/7/65 | 3 | 10/7 | (2) | 21/7 ; 22/7 | [11] | | |
| | 11 | 4/4/66 | 6 | 10/4 ; 10/4 | (6) | 19/4 ; 19/4 | [9] | 29/4 | [10] |
| | 12 | 18/4/66 | 5 | 13/5 ; 13/5 | (25) | | | | |

Note :—Figures in round brackets indicate periods from collection to first hatch.

Figures in square brackets indicate periods between first hatches of consecutive sets.

*naulti* would be expected if *H. brooki* laid eggs after longer intervals. The maximum period between the collection of an egg and its hatching is 39 days for *H. brooki* and 32 days for *H. leschenaulti.*

The eggs of both species are very variable in size. Table 2 shows the sizes of the largest and smallest eggs in each group. The small

TABLE 2

EXTREME SIZES OF EGGS IN DIFFERENT GROUPS

| Group | No. of eggs | Largest egg | Smallest egg |
|---|---|---|---|
| *H. brooki* | | | |
| 4 | 4 | ·86 × ·76 | ·79 × ·69 |
| 5 | 2 | ·84 × ·75 | ·84 × ·74 |
| 8 | 4 | 1·18 × 1·02 | ·89 × ·75 |
| 10 | 2 | ·88 × ·76 | ·87 × ·76 |
| *H. leschenaulti* | | | |
| 3 | 7 | ·87 × ·76 | ·80 × ·68 |
| 7 | 3 | ·85 × ·76 | ·83 × ·74 |
| 11 | 6 | 1·12 × 1·10 | 1·16 × 1·04 |
| 12 | 5 | 1·20 × 1·06 | 1·14 × 0·96 |

variation in size within a group compared to the variation in the species also suggests that a group of eggs is laid by a single female. Darwin (1882, p. 260) and many subsequent authors have remarked on the idiosyncratic quality of hen's eggs. However, much more data will be necessary before this inference is given statistical precision.

## MOVEMENTS

In order to observe the movements of an individual gecko, I first tried painting individuals with different colours of nail varnish. However, the application of the nail varnish almost always induced the lizard to moult it off within 2 or 3 days, so that this method was not successful.[1]

[1] However, in Calcutta, though the nail varnish was sloughed off as quickly as in Bhubaneswar, marking did provide some striking observations. There, in a first floor flat, I had started the routine of catching geckos anywhere in the flat and then releasing them at a fixed place. From these observations, I got the impression that usually during the winter, geckos tended to return as quickly as possible to the place where they were captured. This included a gecko which was released at a spot diagonally across the flat from where it was captured, and had returned to the place of capture in about 12 hours. In the part of the year when they were sexually active however they tended to remain in the room where they were released. In the Calcutta population I have also observed cannibalism, breaking up of a copulation by a third individual leading to vicious fighting, and licking of the genitalia by both sexes after copulation. I have not, however, been able to find out what species the Calcutta population was.

I have, however, been fortunate enough in Bhubaneswar to find several individuals of *H. leschenaulti* with deformities of the tip of the tail which are very good distinguishing marks. 4 different individuals have so far been so distinguished. The first had a tail which was forked at the tip. The second had a double bend at the tip which is, therefore, S-shaped. The third had the tip deflected to the left and the fourth to the right. However only the two former have so far provided data enough to test statistically. Observations on Gecko 1 were started on 21/iv/64, and it has not been seen since 2/viii/65. Observations on Gecko 2 were started on 26/viii/64 and were continued till 3/ii/67. Every time a gecko was seen, the time and the place where it was observed were recorded. These observations were then arranged according to date. This series was then divided into three roughly equal portions for each gecko separately. Results are shown in Table 3. The

Table 3

Observations on movements of two individuals of *H. leschenaulti*

Gecko 1 — Room(s)

| Period | A | C | B, D | Total |
|---|---|---|---|---|
| 8/1-5/2 | 1 | 16 | 4 | 21 |
| 17/2-11/5 | 6 | 7 | 6 | 19 |
| 25/5-25/11 | 15 | 3 | 2 | 20 |

$x_4^2 = 25{\cdot}51$

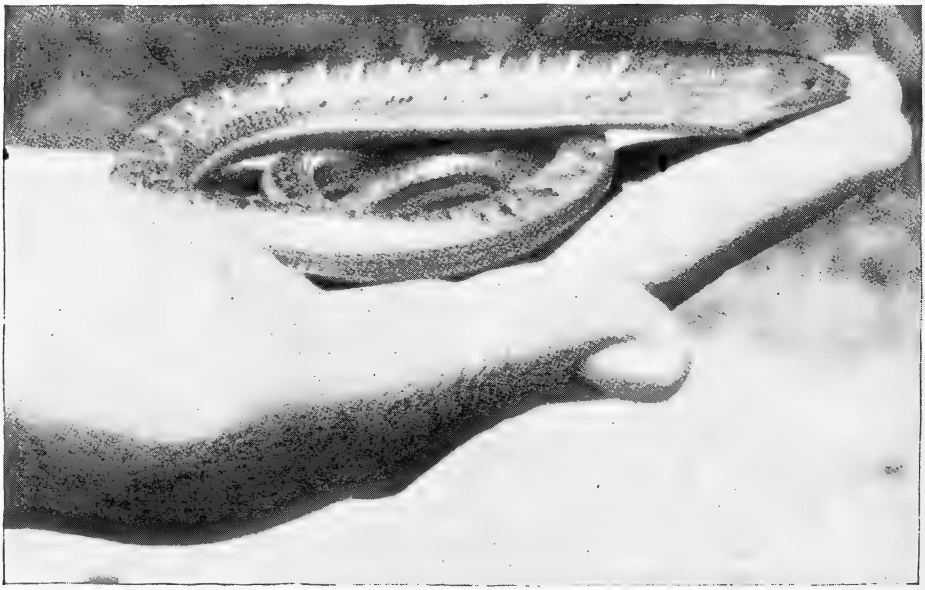
Gecko 2 — Room(s)

| Period | C | ADE | Total |
|---|---|---|---|
| 9/1-19/2 | 26 | 0 | 26 |
| 13/2-15/6 | 18 | 8 | 26 |
| 16/6-24/12 | 17 | 9 | 26 |

$x_2^2 = 10{\cdot}94$

letters A to E each refer to a particular room. The value of $X^2$ in Table 3 for Gecko 1 should be interpreted with caution due to the small numbers. However, the probability of obtaining such a value is so small ($P < 0{\cdot}001$) that we can safely infer that there is a difference in the proportions of observations in different rooms during different parts of the year. In the case of Gecko 2 also the difference is significant ($P < 0{\cdot}01$). Further, since the two latter periods do not show any difference, we can group them into one period. If we do this we get a $2 \times 2$ table with $\chi_1^2 = 10{\cdot}9$ ($P < 0{\cdot}001$). Interpreting this biologically we see that during January and February these lizards are very conservative in their movements, whereas later in the year, that is roughly when they are sexually

*Ophisaurus gracilis* (Gray) on natural habitat



*Ophisaurus gracilis* (Gray) on hand

(*Photos : Mrinal Kanti Sen*)

active, they range over a wider area. From available data, I cannot clearly state what their behaviour is immediately after their breeding season is over. However, during this period Gecko 1 frequented a different room than it did during the winter. Geckos 1 and 2 both spent the winter of 1965-66 behind a cistern in a bath room and were often seen together.

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GOVERNMENT OF ORISSA,
BHUBANESWAR-3,
*September* 23, 1967.

S. D. JAYAKAR[1]

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## 17. OBSERVATIONS ON THE LIMBLESS LIZARD *OPHISAURUS GRACILIS* (GRAY) FROM SHILLONG, ASSAM

(*With a plate*)

The limbless lizards of the genus *Ophisaurus* are uncommon and only one species, *Ophisaurus gracilis* (Gray), occurs in India. This beautiful snake-like lizard was first described by Gray (1845) from Khasi Hills, Assam. I collected nearly half a dozen specimens of the limbless lizard *Ophisaurus gracilis* (Gray) from Shillong. The animal (locally known as *naingbaen*) hides under logs and stones during the day and comes out after sunset in search of food, mainly insects and worms. It is quite harmless, and makes no attempt to bite when handled. It is sluggish, and shams dead when handled. The measurements of the largest specimen in my collection are as follows: snout to vent 185 mm.: tail 284 mm., and girth 38·50 mm. (Plate, figs. 1, 2).

I am thankful to Dr. A. S. Rao, Regional Botanist, Botanical Survey of India, Eastern Circle, Shillong, for a live specimen of limbless lizard for my study.

ZOOLOGICAL SURVEY OF INDIA,
EASTERN REGIONAL STATION,
SHILLONG-4 (INDIA),
*November* 8, 1967.

B. K. TIKADER

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## 18. *PAROXYURICHTHYS LATERISQUAMATUS* (M. WEBER): FIRST RECORD FROM INDIAN WATERS

(*With a photograph*)

*Paroxyurichthys* Bleeker, 1876 is so far known from two species, *Paroxyurichthys typus* Bleeker and *P. laterisquamatus* (M. Weber) (*vide* Koumans, 1953) from Ambon and New Guinea. A single well preserved specimen of *Paroxyurichthys laterisquamatus* was recently discovered in a collection of gobiids by Shri G. Ramakrishna, from the Mahanadi estuary in November, 1962. The other gobiids in the same collection were *Butis butis* (Hamilton), *Periopthalmus vulgaris* Eggert, and *P. barbarus* (L.).

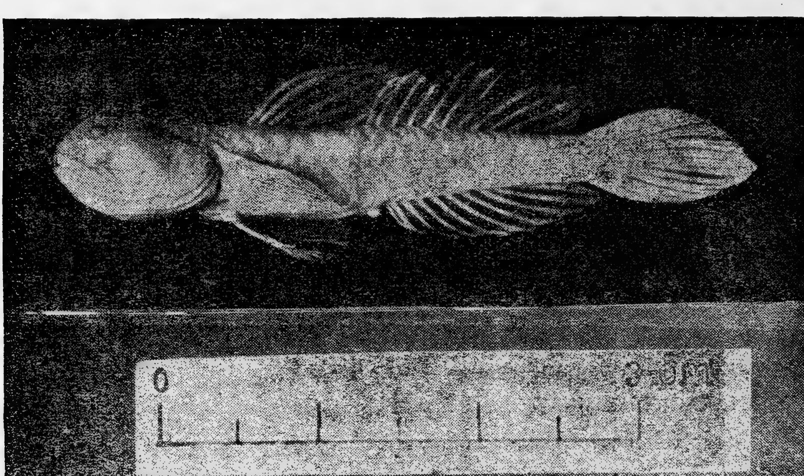
This is the first record of *Paroxyurichthys laterisquamatus* (M. Weber) from Indian waters. The distinguishing characters together with variations observed in the present specimen are given below :

### **Paroxyurichthys laterisquamatus** (M. Weber)

*Oxyurichthys laterisquamatus* M. Weber, 1908, *Nova Guinea* **5**, Zool. 2 ; 271. (type loc : New Guinea) ; Fowler, 1928, *Mem. B. P. Bishop Mus.* **10** : 415.

*Paroxyurichthys laterisquamatus* Koumans, 1953, *Fish. Indo-Austr. Arch.* **10** : 51.

*Material :* One, 45 mm. total length ; Khira Gachha-Madeli, Mahanadi estuary, *c.* 8 km. west of Fisheries Bungalow ; 11-11-1962 ; G. Ramakrishna ; Zoological Survey of India, Reg. No. F. 521/9/2.




*Paroxyurichthys laterisquamatus* (M. Weber)

*Description* :

$D_1$ VI ; $D_2$ I.11 ; A.1.10 ; P. 16 ; L. 1. $\pm$ 60.

Body elongate, compressed, height 6·9 in total length. Head 4·5 in total length. Eye diameter 4·0 in head length, interorbital about half eye diameter. Snout equal to eye diameter. Mouth oblique, lower jaw prominent. Maxillary extends to below posterior half of eye. Teeth small, in 3 rows in both jaws. No canines. No teeth on vomer. Tongue weakly convex in front. Head scaled behind eye. Scales of cheek and opercle cycloid. Scales of body ctenoid posteriorly, cycloid anteriorly. The rays of all fins are very prolonged. Ventral fins united, oblong. Caudal fin long, pointed and as long as head. Colour light brown. Fins hyaline.

The specimen differs in certain details from Koumans' description (1953). The eye is larger and the maxillary is longer extending to the posterior half of the eye.

ACKNOWLEDGEMENTS

The authors are thankful to the Director, Zoological Survey of India for encouragement and to Dr. A. G. K. Menon, Superintending Zoologist, Zoological Survey of India for his helpful suggestions in the preparation of this note.

ZOOLOGICAL SURVEY OF INDIA, P. K. TALWAR
CALCUTTA, T. K. SEN
*May* 5, 1967.

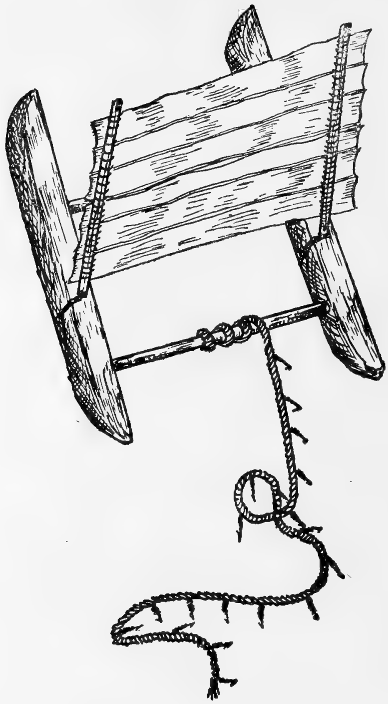
## 19. *MURAL-THOONDI*, A GEAR FOR HALFBEAK FISHES

(*With a text-figure*)

The *mural-thoondi* is an indigenous gear for the capture of halfbeaks in the Gulf of Mannar and Palk Bay (Mandapam area). Capture by this gear is so ingenious as to be worthy of record.

The main part of the gear consists of a miniature sailed raft made up of two parallel pieces of wood about 40 mm. in length and a transverse piece over which palmyra leaves are fixed vertically and serve as a sail. A long line with about 30-40 hooks (text-fig.) is attached to the raft. The hooks are baited and the raft is allowed to drift with the wind. When the halfbeaks are hooked the line is pulled back to the shore and relaid. Polychaetes (*Nereis*, *Heteronereis*), and *Balanoglossus*, dug

out from the sandy shore, are generally used as bait on these lines. Between 20 to 30 fish are caught in a single operation during a good fishing



Mural-thoondi

day. The species commonly caught by this gear are *Hemirhamphus far* (Forsk.) and *Hyporhamphus quoyi* (C. & V.).

CENTRAL MARINE FISHERIES
RESEARCH INSTITUTE,
MANDAPAM CAMP,
*July* 6, 1967.

P. K. TALWAR

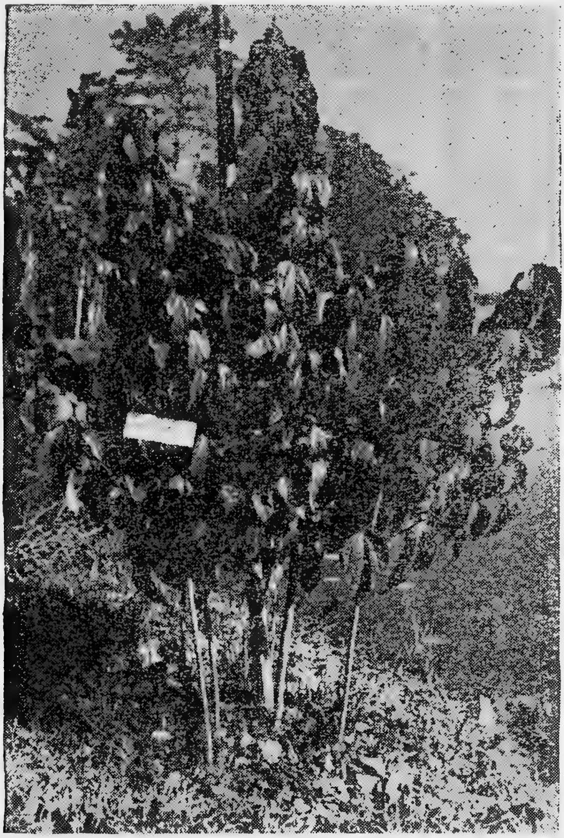
## 20. A NOTE ON THE USE OF *CROTON TIGLIUM* LINN. SEED AS A FISH POISON IN PONDS [1]

(*With a photograph*)

Several plants growing wild or in a state of cultivation are reported to be reputed fish poisons (Chopra *et al.* 1949). Though these plants have been used for catching fish from streams and ponds, hardly any scientific study has been made on their use as fish poisons. During the years 1960-

[1] Published with the kind permission of the Director, Central Inland Fisheries Research Institute, Barrackpore, West Bengal; presented before the 53rd annual session of the Indian Science Congress, 1966.

64 the author was engaged in studies in the use of several plants occurring in Assam for eradication of unwanted fishes from nursery ponds. Studies on three plants viz. *Millettia pachycarpa* (Bhuyan 1967), *Millettia piscidia* (Bhuyan & Vijayalakshmanan, in preparation) and *Croton tiglium* have been completed and a summary of the results with the last plant reported (Barrackpore, C.I.F.R.I., 1964-65 ; Bhuyan 1966).



*Croton tiglium* Linn. plant.
Age—9 months old.
Maximum height attained—165 cm.
Starts flowering in January.

Seeds and oil of *Croton tiglium* are widely used as fish poisons (Chopra *et al.* 1958 ; Nadkarni 1954; Babu 1965). It is commonly available in Assam (local name *Konibin*) and N.E.F.A. (local names *Engosinam* and *Kusere*) and is frequently used by tribal people for killing fish in streams and ponds. According to Hora & Pillay (1962) powdered croton seeds are used by Chinese fish culturists for eradication of unwanted fishes from nurseries before stocking of spawn and fry. The seed kernels of

*Croton tiglium* contain two toxic proteins or 'toxalbumins' (Chopra *et al.* 1956) which 'are essentially blood poisons' (Chopra *et al.* 1949). Babu (1965) reported results of his laboratory studies on the use of seeds of *Croton tiglium* as a fish poison. Results of field trials with *C. tiglium* carried out by the author are briefly reported in the present note.

Field applications of the poison were made in six ponds of 0·025-0·035 hectare water spread, with 0·3 to 0·78 metre depth, and under water temperatures ranging from 20 to 35·5°C. The ponds had either a natural stock of common miscellaneous fishes or they were stocked with them prior to the experiment. The requisite quantity of seed powder was taken in a fine markin cloth bag, kept soaked in water in a bucket for about half an hour and by repeated squeezing of the bag a milky emulsion was obtained. This was diluted and sprayed uniformly on the ponds which were then netted repeatedly with a fine mesh drag net for thorough mixing of the poison. Three doses, 4·0, 4·7, and 5·3 p.p.m. including the non-toxic seed coat which accounts for about 25% of the total weight (corresponding doses of seed kernel powder alone being 3·0, 3·5, and 4·0 p.p.m. respectively) were tried, with two replicates for each concentration. The results are given in the Table.

TABLE

LENGTH CONCENTRATIONS OF *Croton tiglium* SEED POWDER FOR ERADICATION OF COMMON FRESH-WATER FISHES IN PONDS

| Concentrations p.p.m. | Temperature range °C | Species of fishes killed within 3 to 6 hours of exposure |
|---|---|---|
| 4·0 (3.0) | 22·5-33·5 | *Amblypharyngodon mola, Anabas testudineus, Cirrhinus mrigala, Clarius batrachus, Colisa fasciata, Esomus danrica, Glossogobius giuris, Labeo gonius, Labeo rohita, Macrognathus aculeatum, Mystus bleekeri, M. seenghala, M. tengara, Nandus nandus, Notopterus notopterus, Ompok bimaculatus, Ophicephalus punctatus, Oxygaster bacaila, Puntius sophore, Rasbora elanga,* and *Wallago attu.* |
| 4·7 3·5 | 20·0-22·3 | All the above plus *Cyprinus carpio, Heteropneustes fossilis,* and *Ophicephalus gachua.* |
| 5·3 (4·0) | 20·3-25·0 | -do- |

As may be seen from the Table, 4 p.p.m. of the seed powder (i.e. 3 p.p.m. seed kernel powder) was sufficient to eradicate most of the common fresh-water fishes including the larger predators like *Wallago attu* and *Mystus seenghala* within three to six hours. With a slightly higher concentration of about 5 p.p.m. of the seed powder even hardy

air breathers like *Ophicephalus gachua* and *Heteropneustes fossilis* were eliminated.

The action of the poison on the fishes is not violent. The affected fishes came to the surface, showed occasional convulsive movements and gradually died. The fishes could not be revived when transferred to fresh water immediately after they are affected. The doses applied did not kill prawns and insects like notonectids, coleopterans or hemipteran bugs. Though zoo-planktons were killed they were found to develop again about a week after treatment. The poison caused no adverse changes in the physico-chemical conditions of water. The toxicity of the poison was not affected by low temperatures.

According to Babu (1965) fishes like *Ophicephalus* spp., *Anabas*, *Tilapia* and *Heteropneustes* are killed within about 3 hours by 4 p.p.m. of the seed powder and within about 6½ hours by 3 p.p.m. and toxicity persists only for 72 hours with 4 p.p.m. However, the present field studies indicate that about 5 p.p.m. was necessary for complete eradication of all fishes commonly found in ponds and the toxic effect of such a dose persists for 3-4 days.

Thus the seeds of *C. tiglium* provide a useful fish poison which unlike root poisons, can be collected without destroying the plant. The plant under favourable conditions bears fruits when about two years old and continues to yield for several years. From a full grown plant about 8-10 kg. of fruits can be collected every year which will give about 3-3·5 kg. of seeds. This will be sufficient for clearing six nurseries each of 0·02 hectare water spread, with an average depth of 1 metre.

## Acknowledgements

The author is grateful to Mr. K. H. Alikunhi for guidance in this work and to Dr. M. T. Philipose and Mr. S. Parameswaran for help in preparation of this note.

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## 21. NOTES ON ANIMAL RELATIONSHIPS: DROMIID CRABS, *CRYPTODROMIA TUBERCULATA PILEIFERA* ALCOCK, 1899 SHELTERING BENEATH COMMENSAL SPONGES

Whilst collecting marine fauna in the inshore regions of Great Nicobar Island during February-May 1966, an interesting animal association between dromiid crabs and hemispherical commensal sponges was observed. The details of this association together with some experimental observations are presented in this note.

The inshore region of Great Nicobar Island is mainly coralline interspersed with sandy patches and rock boulders. The coral reefs abound in madreporarian corals and harbour an extremely rich fauna including sponges. Among the sponge fauna, there were a number of small hemispherical forms, ranging in diameter from 15 mm. to 18 mm. on corals exposed in the intertidal region during low tide.

As the apparent movements of these sponges attracted attention these were picked up, and it was found that each hemispherical sponge sheltered a small crab underneath. On examination the crab was seen holding the sponge as a cap by means of the last two pairs of ambulatory legs.

In addition to the specimens examined and experimented upon in the field, the following material was brought to Calcutta for study:

| *No. of sets* | *Stn. No.* | *Collection No.* | *Date* | *Locality* |
|---|---|---|---|---|
| 1. One | 1 | 221 | 6.3.66 | From low tide region of Campbell Bay. |
| 2. Two | 10 | 776 | 2.4.66 | From low tide region of Casuarina Bay. |
| 3. Six | 20 | 1122 | 15.4.66 | From low tide region of Shivdutt Bay. |

Following Alcock (1901) and Buitendijk (1950), the crabs have been identified as *Cryptodromia tuberculata pileifera* Alcock, 1899, belonging to the family Dromiidae. The carapace of the largest specimens (male and female) are 8·5 mm. long and 10·5 mm. broad. The older collections of Z.S.I. comprise specimens from Port Blair, Great Cocos Islands and Little Andaman Island.

The sponges are all encrusting forms belonging to the family Suberitidae.

## Observations

The following observations have been made in the field-laboratory :

Three sets of animal association obtained on 2-4-66 from Casuarina Bay were left in separate bowls containing sea-water. At the bottom of the bowl some sand and pieces of corals and rock were arranged to simulate conditions of the inshore region at low tide. The sponge caps were carefully dislodged from the crabs and the associates were released in the same containers. Within two hours the crabs had covered themselves with the detached caps, in all the three bowls.

In a second series of experiments where specimens of denuded *Cryptodromia* were released into large tanks containing sea-water along with live encrusting sponges and were not provided with removed sponge caps, it was observed that the crabs broke off pieces of live sponges and held them by their last two pairs of legs over their backs pressed close to their carapace.

In a third series of experiments where these specimens of *Cryptodromia* were released into tanks containing simple ascidians, empty bivalve shells, encrusting sponge etc. it was noticed that the crabs did not use the material other than encrusting sponges for protecting their carapace.

## Remarks

These observations reveal that these dromiid crabs prefer any encrusting sponge for protective purposes, because the sponge may eventually spread over the entire carapace. According to Alcock (1902) and Hyman (1940) the members of the family Dromiidae have the habit of sheltering under small animals such as sponges, ascidians, and empty valve of lamellibranch shells. In the case of *Cryptodromia tuberculata pileifera* Alcock it is probable that it covers itself only with any easily available species of encrusting sponge.

This type of bipartite relationship between sponges and crabs is probably mutually beneficial. Because of the disagreeble taste and odour as well as the bristly spiculation, sponges are seldom eaten by other animals (*vide* Hyman 1940) and therefore are of benefit to the crabs for shelter and protection. The sponges, however, are benefited to a limited extent only. Being sedentary in habit they get the advantage of being carried from place to place and also obtain small particles of food scattered about by the crab.

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CALCUTTA,
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## 22. GREGARIOUSNESS AND MIMICRY DURING COCOON STAGE BY THE BUTTERFLY *EUREMA HECABE* (L.)

In the month of August 1965 at Shillong, I observed that almost all *Acacia mollissima* Willd. and *Albizzia* sp. trees were heavily infested by whitish green caterpillars, subsequently identified as the larvae of *Eurema hecabe* (L.).

Within a month's time the attacked plants were completely defoliated by the caterpillars and just after complete defoliation, the caterpillars started to make their leaf-like cocoons on the naked leaf midribs of the host-plant. The cocoons were arranged serially and hung by their stalk in such a way on the midribs that they looked like the leaves of the plant. The size and shape of the cocoons were nearly the same as that of the leaf of the host plant.

I counted more than a hundred cocoons hanging in a small infested branch. It was a beautiful example of gregariousness and mimicry by butterfly cocoons.

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SHILLONG-4, ASSAM,
*July* 23, 1966.

B. K. TIKADER

## 23. ON THE SEASONAL FLUCTUATIONS AND BIOLOGY OF *ANAPHOTHRIPS FLAVICINCTUS* (KARNY) ON *PANICUM MAXIMUM* IN MADRAS

(*With six text-figures*)

Studies on *Anaphothrips flavicinctus*, one of the common grass infesting species in south India and often called the 'wheat thrip' in other parts, are limited to its taxonomic position (Schmutz 1913, Karny 1919, Shumsher Singh 1942), its bionomics in relation to the wheat plant (Patel & Patel 1953) and alary polymorphism (Ananthakrishnan 1961). In view of their occurrence in considerable numbers on *Panicum maximum*, the guinea grass throughout the year, an attempt was made to observe their fluctuations in density, in relation to variations in climate involving temperature, relative humidity, rainfall and wind velocity for a period of two years, 1965-67.

For the purpose of estimating the density of the population 40 sweeps were taken as the unit of a count with each sweep not overlapping the preceding one (Cederholm 1963). Relative humidity was measured by using a hair hygrometer and the temperature with a standard centigrade thermometer, with both the instruments placed within the rows of grasses at the time of collection. Wind velocity and rainfall were obtained from the Meteorological Observatory, Nungambakkam, very near the site of investigation. The thrips collected alive were narcotised with ether vapour, counted and subsequently on activation, released on to the host. For studies of their life cycles, the individuals were reared on pot plants in the laboratory.

Both sexual and parthenogenetic modes of reproduction occur in this species. Larvae hatched from random eggs were reared and on becoming adults, the sexes were isolated and both types of reproduction studied. Adults were observed to mate 36-48 hours after emergence and copulation lasts for about five minutes. The first batch of eggs is laid 2-4 days after copulation. The time taken to lay a single egg ranges

from 5-10 minutes. Prior to oviposition, the female moves its antennae and abdomen in various directions, the abdomen subsequently arching upwards, introducing the ovipositor into the leaf tissue at an angle, and laying the eggs parallel to the veins. The parthenogenetic female was observed to have a longer oviposition period and often laid more eggs than the fertilised female. Presumably the increased longevity of the parthenogenetic female is the causal factor. The rate of oviposition during the months of January-February is 7-8 for the first 3-4 days and gradually decreases and oviposition is completed after 6-8 days. On the other hand oviposition records during the months July-August, reveal that the adults have a comparatively shorter longevity during this period and the oviposition rate is correspondingly higher. The oviposition period was also less and rate of oviposition per day high. This appears to be an adaptation to cope up with the increased temperature during these months.

TABLE 1

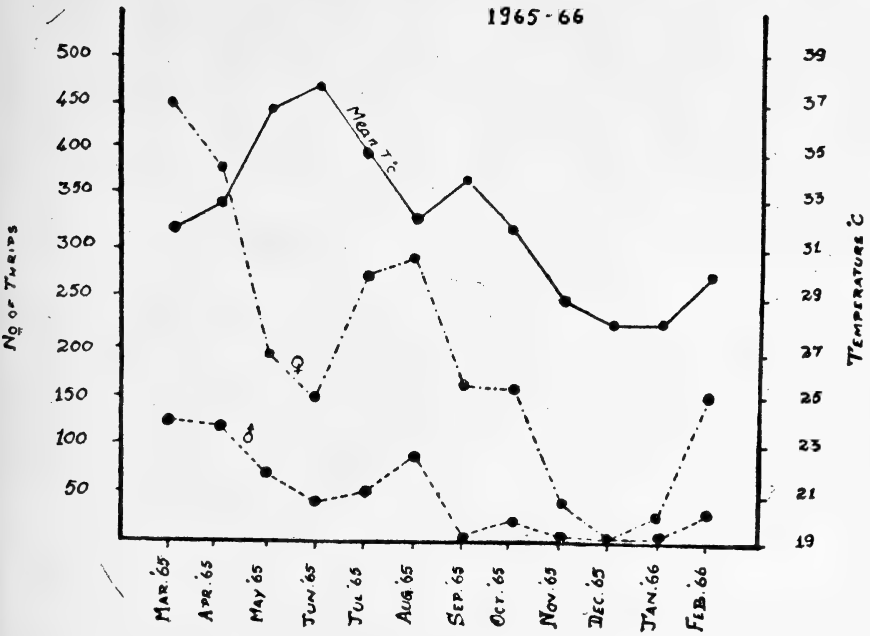
OVIPOSITION RECORDS FOR 1966

| Average temperature | Type of reproduction | Pre-oviposition period | Oviposition period | Post-oviposition period | No. of eggs per day | Total eggs laid | Adult female longevity |
|---|---|---|---|---|---|---|---|
| | | | *January-February* | | | | |
| 25-28°C | Sexual | 2-3 days | 6-8 days | 6-8 days | 3-7 | 20-47 | 16-21 |
| 25-28°C | Parthenogenetic | 3-4 days | 9-10 days | 6-9 days | 4-8 | 41-56 | 18-23 |
| | | | *July-August* | | | | |
| 33-36°C | Sexual | 1-2 days | 4-5 days | 4-5 days | 5-13 | 25-52 | 11-14 days |
| 33-36°C | Parthenogenetic | 2-3 | 5-6 | 6-7 | 9-13 | 54-65 | 13-16 days |

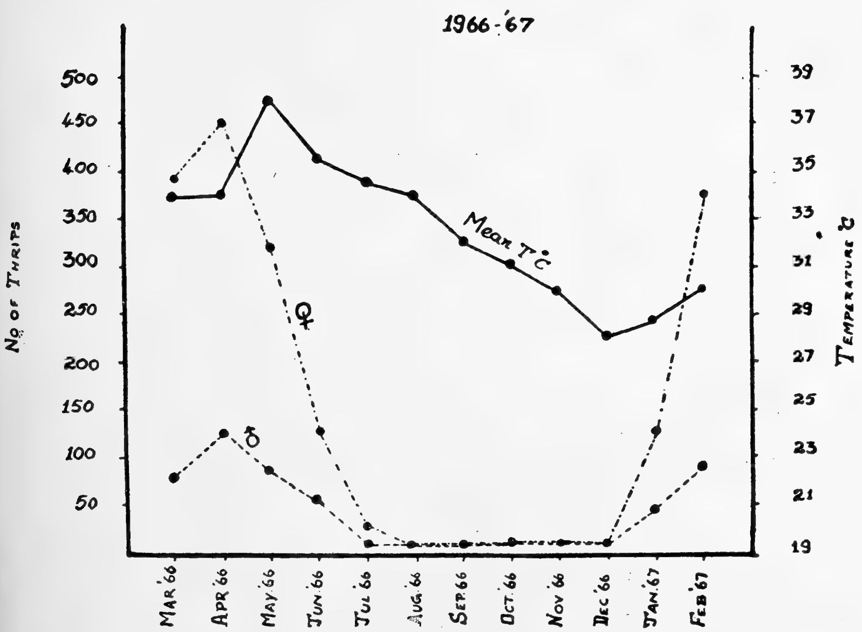
Egg mortality in either type of reproduction was almost as high as 50% and heavy mortality (50%) also occurred in the first instar larvae. All the parthenogenetically reproduced offspring were females and in the case of sexual reproduction, 92% were females.

*Duration of Instars at different temperatures*

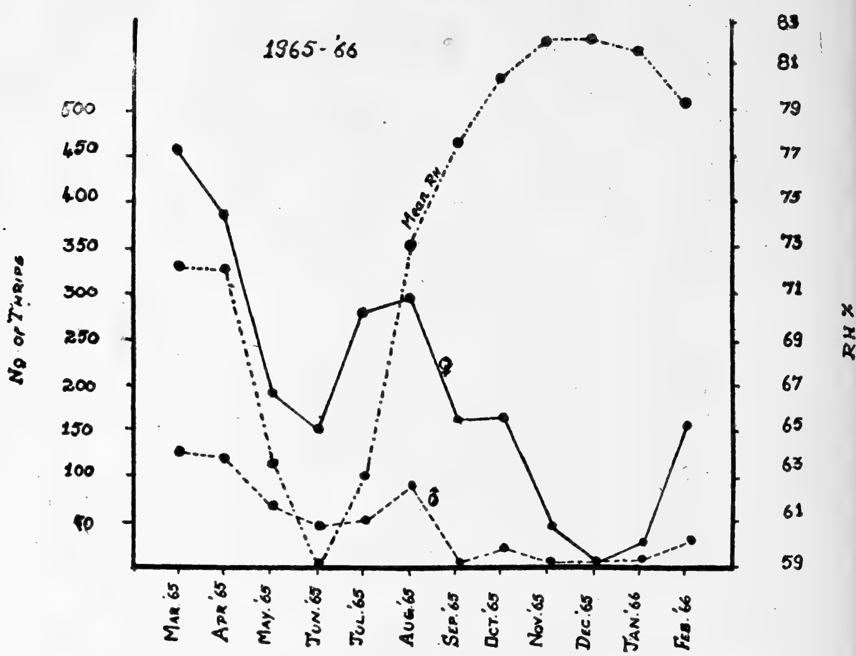
As in the case of the oviposition records, the duration of the various larval instars fell within the same range in both the sexual and parthenogenetically reproducing individuals, but it was influenced by temperature. The duration was observed to be shorter in the individuals reared in July-August when the average temperature was higher.



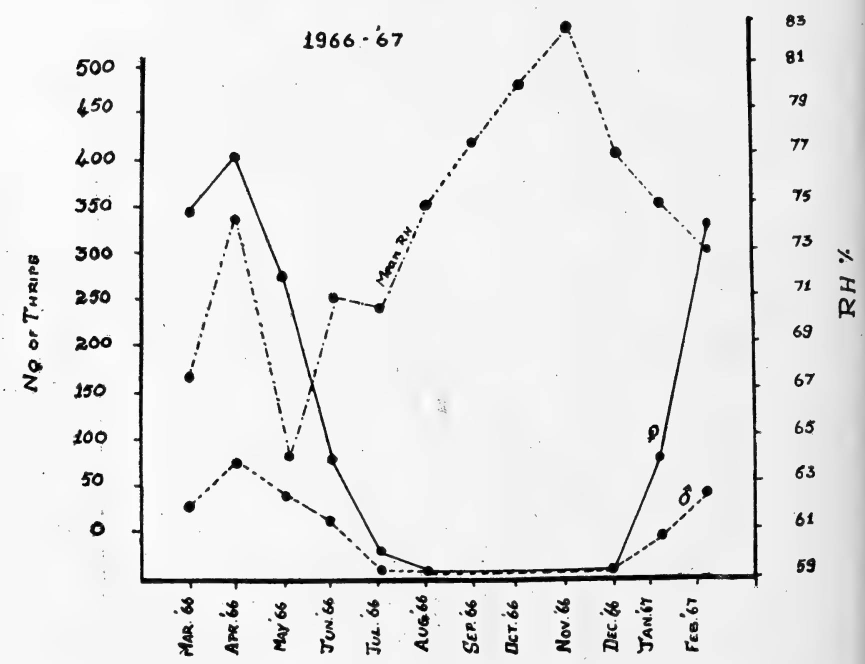

Graph I. (*a*) Fluctuations in relation to Temperature



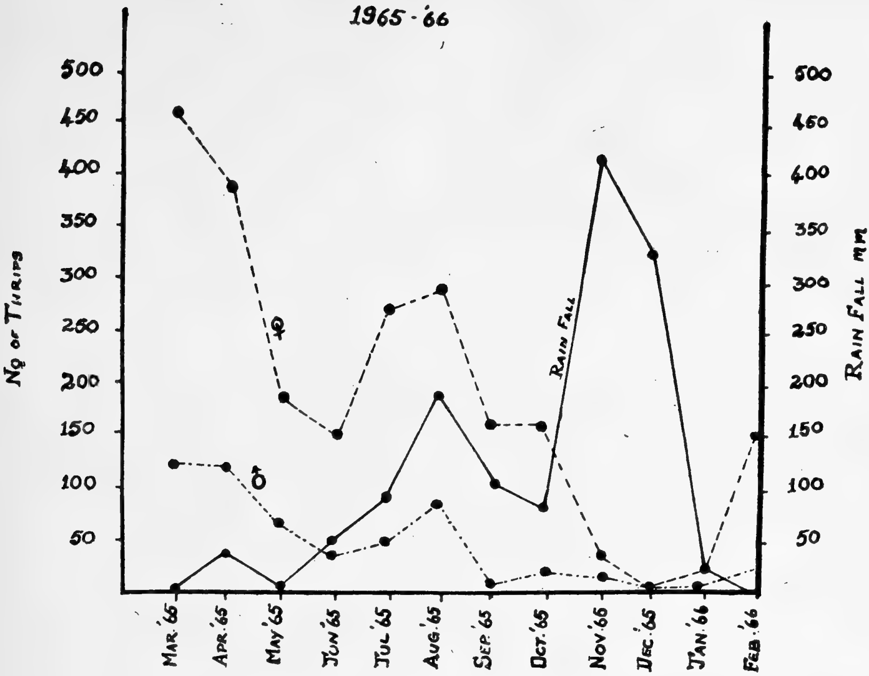

Graph I. (*b*) Fluctuations in relation to Temperature



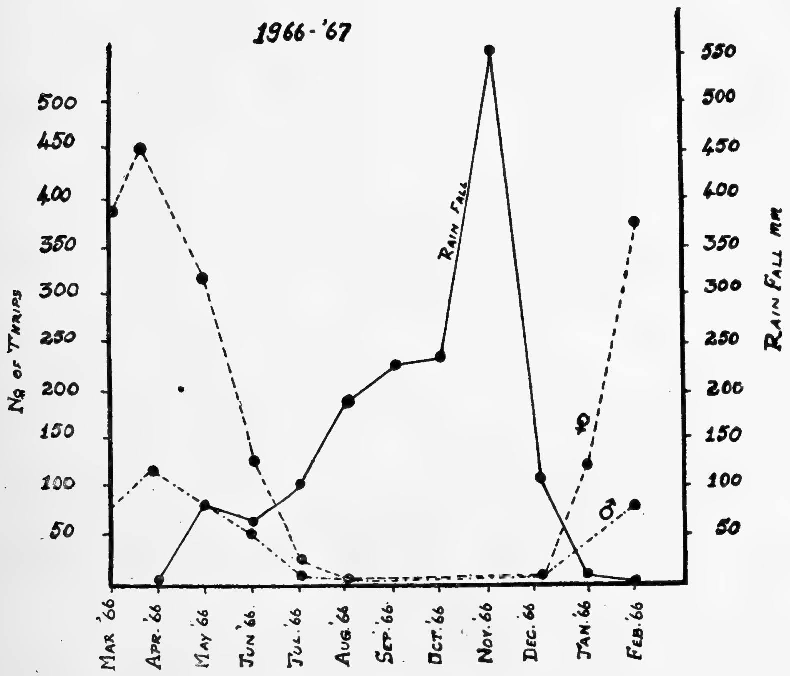

Graph II. (*a*) Fluctuations in relation to relative humidity




Graph II. (*b*) Fluctuations in relation to relative humidity




Graph III. (*a*) Fluctuations in relation to rainfall




Graph III. (*b*) Fluctuations in relation to rainfall

TABLE 2

DURATION OF LARVAL INSTARS IN 1966
(Average temperature 25-28°C)

| S.No. | Stage | No. observed | Duration in days | |
|---|---|---|---|---|
| | | | Maximum | Minimum |
| | | *January-February* | | |
| 1 | Egg | 27 | 9 | 5 |
| 2 | Ist instar | 14 | 3 | 2 |
| 3 | IInd ,, | 11 | 6 | 4 |
| 4 | Prepupa | 12 | 2 | 1 |
| 5 | Pupa | 10 | 4 | 3 |
| | | *July-August* | | |
| | | (Average temperature 33-36°C) | | |
| 1 | Egg | 21 | 6 | 3 |
| 2 | Ist instar | 12 | 3 | 2 |
| 3 | IInd ,, | 12 | 5 | 3 |
| 4 | Prepupa | 11 | 1 | 1 |
| 5 | Pupa | 11 | 3 | 1 |

An analysis of the density of thrips populations for the two years shows that in both the years the number of thrips was highest (400-450) during the months February-April, when the temperature range was 31-34°C, relative humidity 72-75% and rainfall is insignificant. There was a distinct fall in number (125-250) in both the years during the months May and June when the temperature range was 36-38°C, the relative humidity 59-67%. The number again showed an increase in July-August 1965 (300) when the temperature, humidity and rainfall were the same as in February-April, but it was practically negligible for the corresponding period in 1966 due to regular and increasing amounts of rainfall (150-250 mm.). During the months November-December the counts, were almost nil in both the years due to heavy rainfall (450-550 mm.) high relative humidity (80-90) and low temperature (28-29°C). As such the optimum conditions appear to be a temperature range of 31-34°C, relative humidity 72-75%, and insignificant rainfall.

LOYALA COLLEGE,
MADRAS-34
*August* 8, 1967.

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## 24. FURTHER DATA ON HOST-PLANTS OF LAC INSECTS (TACHARDIIDAE, HOMOPTERA)

An additional list of host-plants of lac insects has become necessary, in view of the delay between the original submission of the supplementary (world) list of lac-hosts in 1963 and its publication in the previous issue of the *Journal* [Vol. **64** (3): 488-511] in 1968, despite two revisions in 1964-65 and additional corrections on the proof. This list comprises more records of lac host-plants from India which I have come across since we submitted the main list. Further, the nomenclature of some lac-hosts has been revised in accordance with recent literature by Maheshwari (1963), Raizada (1966) and Santapau (1967).

1. **Abrus precatorius** Linn. (Leguminosae). Lac cells were observed on it, while the shrub twined on a lac-inoculated *Butea monosperma*, at Rajnagar, Madhya Pradesh (Mehra & Gokulpure 1967, pp. 695, 703).
2. **Acacia planifrons** W. & A. (Leguminosae). Lac bearing tree of Travancore (Barker 1921, p. 8).
3. **Alchornea tiliaefolia** Muell.-Arg. (Euphorbiaceae). *Laccifer* (now *Kerria*) *chinensis* (Mahdihassan) was found in small colonies with good encrustations of lac on it, in Mungpu forest and adjoining areas in Darjeeling District, West Bengal (Ghose 1963, p. 125).
4. **Atylosia scarabaeoides** Benth. (Leguminosae). It was found carrying sparse and small cells of *aghani* lac at Jhalda, West Bengal (Das Gupta & Mehra 1967, pp. 332, 336).
5. **Combretum ovalifolium** Roxb. (Combretaceae). New lac-host recorded from Rajnagar, Madhya Pradesh; the shrub rested on a lac-inoculated *Butea monosperma* (Mehra & Gokulpure 1967, pp. 695, 701).
6. **Hardwickia pinnata** Roxb. (Leguminosae). Lac bearing tree of Travancore; only one specimen of lac seen on it. Locally called as 'acha' (Barker 1921; p. 10).
7. **Hemidesmus indicus** Sch. (Asclepiadaceae). New lac-host recorded from Compt. 109, Madhya Pradesh; the shrub was twining round a lac-inoculated *Zizyphus xylopyra* (Mehra & Gokulpure 1967, pp. 696, 701).
8. **Marlea begoniifolia** Roxb. (Alangiaceae). Syns. *Alangium chinense* (Lour.) Harms; *A. begoniifolium* (Roxb.) Baill. It is one of the recorded hosts of the Indian lac insect in Assam [*vide*, WEALTH OF INDIA, Raw materials, **6** (L-M), 1962, p. 304].
9. **Vitis** sp. (Vitaceae). New lac-host found at Bamhani and Katangi, Madhya Pradesh (Mehra & Gokulpure 1967, pp. 696, 701).
10. **V. latifolia** Roxb. [=*Ampelocissus latifolia* (Roxb.) Planch.]

(Vitaceae). New lac-host recorded from Rajnagar, Madhya Pradesh ; the vine was climbing a *Butea monosperma* (Mehra & Gokulpure 1967, pp. 696, 701).

The nomenclature of certain earlier known lac host-plants, given in Roonwal-Raizada list, has recently undergone changes. These plants, with their new name first, are noted below, in order to make the list more useful.

### Leguminosae

1. *Acacia nilotica* (Linn.) Del. subsp. *indica* (Benth.) Brenan Syn. *A. arabica* (Lamk.) Willd.
2. *A. polyacantha* Willd. Syn. *A. suma* Buch.-Ham.
3. *A. sinuata* (Lour.) Merr. Syns. *A. concinna* DC., *A. rugata* Merr.

### Moraceae

4. *Ficus virens* Ait. Syns. *F. lacor* auct. non Buch.-Ham., *F. infectoria* Roxb., *F. lucescens* Blume.
5. *F. microcarpa* Linn. f. Syns. *F. benjamina* auct. non Linn., *F. retusa* auct. non Linn.

### Dipterocarpaceae

6. *Shorea roxburghii* G. Don. Syns. *S. talura* Roxb., *S. robusta* Roth non Gaertn f., *S. laccifera* Heyne ex Wall., *Vatica laccifera* W. & A. (Kashyapa 1961, pp. 543-544).

### Rutaceae

7. *Pleiosperonium alatum* (Wall. ex W. & A.) Syn. *Limonia alata* Wall. ex W. & A.

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## 25. PARASITES, PREDATORS AND OTHER NATURAL ENEMIES OF SUGARCANE PESTS IN MAHARASHTRA

Sugarcane is one of the major commercial crops extensively grown in Maharashtra State, in an area of about 3·75 lakh acres. Forty-four species of pests including borers, fulgorids, coccids, etc. have been recorded to infest the crop and they are a serious menace to its successful cultivation. Of these, the internal feeders are very difficult to control with modern pesticides. Attempts are therefore being made in various countries for their successful control through large scale use of their natural enemies, thereby saving huge annual losses.

A beginning in this direction has already been made in India and various workers have recorded several natural enemies of sugarcane pests in States like Mysore, Bihar, Madras, etc. Krishnamurti & Usman (1954) have described about 20 different parasites on sugarcane pests while Gupta (1954), and Gupta & Awasthi (1956) have given a brief account of the parasites of sugarcane pests recorded in north India. Butani (1958) has listed about 99 species of parasites and predators recorded on the pests of sugarcane throughout India. A brief account of about 40 natural enemies recorded in Mysore State with details of their alternate hosts, time of occurrence, the percentage parasitization etc. is given by Shivashankara Sastry & Appana (1958). Besides recording the natural enemies, attempts for large scale multiplication of the promising species with a view to controlling the noxious pests, have also been made. (Puttarudriah & Usman 1958, Puttarudriah & Sastry 1958, Subramaniam 1937, Tirumala Rao *et al.* 1954).

However, in Maharashtra, the use of these natural enemies in controlling harmful pests of sugarcane has not been fully exploited except

TABLE

| Sr. No. | Parasite or Predator | Host recorded in Maharashtra | Locality | Period of maximum activity | Previous records and references |
|---|---|---|---|---|---|
| | | | **Parasites** | | |
| | | | Order HYMENOPTERA | | |
| Family | Braconidae | | | | |
| 1. | *Apanteles taprobanae* Cam. | Eggs of Stem borer, *Chilotraea infuscatellus* Sn. | Padegaon, Satara | August | Recorded at Bangalore on crab caterpillar *Stauropus alternus* Wlk. infesting tur (*Cajanus*) (Krishnamurti & Usman 1954). |
| 2. | *Stenobracon deesae* Cam. | Larvae/pupae of *Scirpophaga nivella* F. (Top-shoot borer) | ,, | June & August | Recorded in Bihar, Madras, Mysore, Punjab, U.P., on *S. nivella* F., *B. steniella*, *C. zonellus* S., *C. infuscatellus* Sn., *C. auriella*, (Butani 1958, Krishnamurti & Usman 1954). |
| 3. | *Apanteles flavipes* Cam. | Larvae of *C. infuscatellus* Sn. (Stem borer) | ,, | October to January | Recorded as a larval parasite of *Sesamia inferens* Wlk., *Chilo zonellus* S., *C. infuscatellus* and hairy caterpillar, *Amsacta albistriga* Wlk. in Bangalore & Mandya. (Krishnamurti & Usman 1954) Butani (1958) reported it from Bihar, Madras and U.P. on *S. nivella*, *Chilo zonellus*, *C. infuscatellus*, *P. indicus* etc. |
| Family | Sclionidae | | | | |
| 4. | *Telenomus dignus* G. | Eggs of *S. nivella* F. (Top-shoot borer) | ,, | July & August | First record in Maharashtra. |
| 5. | *T. dignoides* N. | Eggs of *S. nivella* F. | ,, | June to August | Eggs of *S. nivella* in Mysore. (Krishnamurti & Usman 1954) |

| Sr. No. | Parasite or Predator | Host recorded in Maharashtra | Locality | Period of maximum activity | Previous records and references |
|---|---|---|---|---|---|
| 6. | *Telenomus* sp. | Eggs of *Chilotraea infuscatellus* Sn. | Lakhmapur, Nasik | July & August | Eggs of ragi stem borer (*Sesamia inferens* Wlk.) in Mysore, (Krishnamurti & Usman 1954). |
| 7. | *T. beneficiens* Zehnt. | Eggs of *S. nivella* F. | Padegaon, Satara | July | Recorded as an egg parasite of *C. infuscatellus*, *P. indicus*, *S. nivella* F. and paddy stem borer *S. bipunctifer* Wlk. in Mysore. In Maharashtra, reported to parasitize the eggs of various sugarcane borers (Anonymous 1953). |
| Family | Eulophidae | | | | |
| 8. | *Tetrastichus pyrillae* Craw. | Eggs of *Pyrilla* sp. | ,, | July | It is reported from Bihar, Delhi Hyderabad, Punjab, Mysore, U.P. as an egg parasite of *Pyrilla perpusilla* Wlk. (Butani 1958) Narayanan & Kundanlal studied its bionomics in 1953. |
| 9. | *Tetrastichus* sp. | Eggs of *Scirpophaga nivella* F. | ,, | November | Recorded at first by Subramanyam in 1939 as an egg parasite of *nivella* in Mysore. |
| 10. | *Tetrastichus* sp. | Pupae of *Sesamia inferens* Wlk. | ,, | July | Reported as pupal parasite of *C. infuscatellus* and *S. nivella*. (Anonymous 1958). |
| Family | Trichogrammatidae | | | | |
| 11. | *Trichogramma* sp. | Eggs of *Chilotraea infuscatellus* | ,, | July-August | Egg parasite of ragi stem borer *S. inferens* Wlk. (Krishnamurti & Usman 1954). Some other species of this genus have also been reported to parasitise the eggs of *C. infuscatellus* Sn. and *S. nivella* F. in Mysore (Shivashankara Sastry & Appana 1958). |

| Sr. No. | Parasite or Predator | Host recorded in Maharashtra | Locality | Period of maximum activity | Previous records and references |
|---|---|---|---|---|---|
| Family | Encyrtidae | | | | |
| 12. | *Anabrolepis* sp. | Scale insects, *Aspidiotus glomeratus* G. | Lakhmapur, Nasik | Sept. Dec. | First recorded in Maharashtra in 1963. Narayanan *et al.* (1957) reported *Anabrolepis mayurai* as a primary parasite of sugarcane scales. (*A. glomeratus* G.). |
| 13. | *Anagyrus saccharicola* Timb. | Mealy bugs, *Trionymus sacchari* Ckll. | Hadapsar, Poona | June & July | Recorded for the first time in 1939 by Mani in the Punjab. Reported on various coccids infesting sugarcane including *Saccharicoccus sacchari* Ckll. (Butani 1958, Krishnamurti & Usman 1954, Shivashankara Sastry & Appana 1958). |
| 14. | *Elasmus zhentneri* Ferr. | Pupae of *S. nivella* F. | Padegaon, Satara | January | Reported as a larval parasite of *Scirpophaga* sp. by Cherian & Israel (1937). It was also reported from Java, Formosa and north India. |
| | | | Order DIPTERA | | |
| Family | Tachinidae | | | | |
| 15. | *Sturmiopsis inferens* | Larvae of internode borer *Sesamia inferens* Wlk. | ,, | March to May | Previously reported as *Sturmiopsis semiberbis* Bezzi on the larvae of *S. inferens* Wlk. in Bangalore Mandya and Chitaldrug (Krishnamurti & Usman 1954). It is also recorded on the larvae of *Chilo zonellus* S. and *C. infuscatellus* P. (Shivashankara Sastry & Appana 1958). |

| Sr. No. | Parasite or Predator | Host recorded in Maharashtra | Locality | Period of maximum activity | Previous records and references |
|---|---|---|---|---|---|
| 16. | *Mepachymerus tenellus* Beck. | Larvae of *C. infuscatellus* Sn. | ,, | February | Recorded for the first time in Maharashtra in the year 1963. |
| 17. | *Scoliophthalmus micans* Lamb. | Larvae of top-shoot borer *Scirpophaga nivella* F. | ,, | February | First recorded in Maharashtra State in 1965. |
| | **Predators** | | | | |
| | Order Coleoptera | | | | |
| | Family Coccinellidae | | | | |
| 18. | *Nephus* sp. | Mealy bugs *Trionymus sacchari* Ckll. | Lakhmapur, Nasik | June & July | Reported on cotton aphids, *Aphis gossypii* Gl. from Mysore (Puttarudriah & Channa Basavanna 1957). |
| 19. | *Chilocorus nigritus* Fb. | Castor scales *Sessetia nigra* on castor and *Aspidiotus glomeratus* G. on sugarcane | Deolali, Nasik | May-June, October, November | Described by Stebbing (1903). Polyphagous species feeding on coccids, aphids, aleurodids, psyllids etc. |
| 20. | *Pharoscymnus horni* W. | Sugarcane scales *Aspidiotus glomeratus* G. | Lakhmapur, Nasik | | Reported from tropical countries. In Indian Union, recorded from Mysore, Madras, M.P. etc., on sugarcane mealy bugs *T. sacchari* Ckll. and hard scales infesting other crops (Puttarudriah & Channa Basavanna 1956). |
| | **Entomogenous Fungl** | | | | |
| 21. | *Sporotrichum* sp. | Sugarcane scales, *A. glomeratus* G. | Entomology Section, Poona | | Recorded for the first time in the year 1965 in Maharashtra State. |
| 22. | *Fusarium* sp. | ,, | ,, | | ,, |

for the attempts made for large scale multiplication of *Trichogramma minutum* Riley and *Tetrastichus* sp. egg and pupal parasites respectively, for the control of sugarcane borers (Bagal & Patel 1952 ; Anonymous 1958). It was, therefore, felt necessary to carry out detailed survey of the major sugarcane growing areas of the State and record natural enemies of the pests of sugarcane crop. The information regarding the host-range, locality, period of occurrence etc. of the various species recorded is given above in a tabular form which would be useful in undertaking further work on successful utilization of some of the promising natural enemies in controlling these pests.

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*May* 17, 1967.

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## 26. A NEW SPIDER OF THE GENUS *ISCHNOTHYREUS* SIMON (FAMILY OONOPIDAE) FROM INDIA

(*With five text-figures*)

The spiders of the family Oonopidae are little known in India and the genus *Ischnothyreus* Simon, has not been reported previously from India. While examining a spider collection from Shillong, I came across a new species of spider of the genus *Ischnothyreus*, which is described here.

The type specimen will in due course be deposited in the National Zoological Collections, Zoological Survey of India, Calcutta.

### **Ischnothyreus shillongensis** sp. nov.

*General :* Cephalothorax reddish-brown, legs and abdomen green. Total length 2·80 mm. Carapace 1·20 mm. long, 1·10 mm. wide ; abdomen 1·70 mm. long, 1·00 mm. wide.

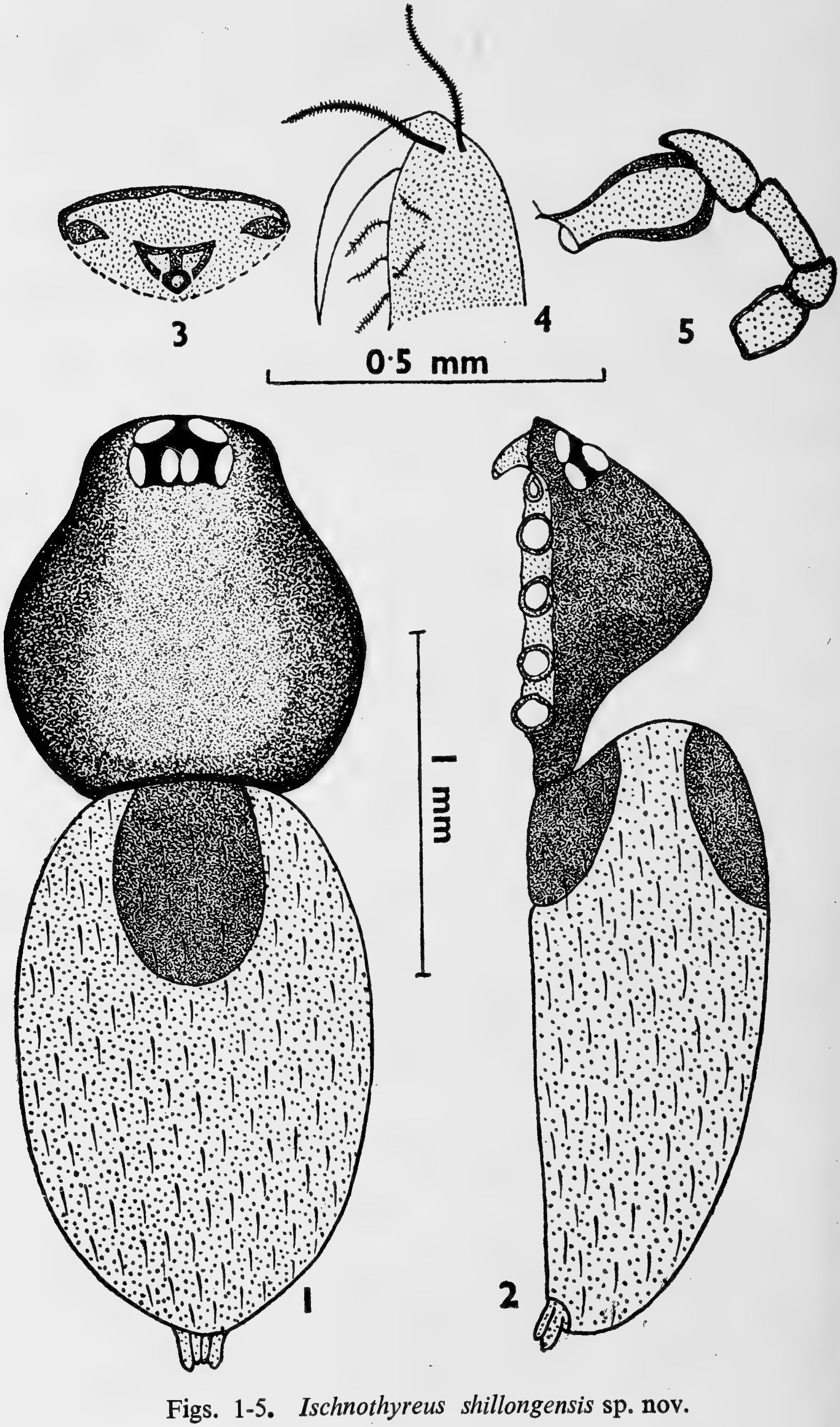
*Cephalothorax :* Slightly longer than wide or nearly as long as wide, clothed with fine hairs. Middle of cephalothorax high and sloping both sides. Eyes six and pearly white but posterior median eyes less white than others, arranged in two rows, posterior median eyes smaller than others. Ocular area provided with conspicuous black patch. Clypeus moderate. Chelicerae vertical, boss absent, double row of hairs beside promargin, tooth and denticle absent (fig. 4). Sternum heart-shaped, longer than wide, clothed with fine hairs, mid-anteriorly with a longitudinal black mark. Legs clothed with fine hairs and a few spines. Femora and tibiae of I and II legs with three and four robust ventral spines respectively.

*Abdomen :* Nearly elliptical, clothed with hairs. Anterior side provided with small conspicuous scutum (figs. 1 and 2). Ventral side slightly lighter than dorsal, and anterior portion up to epigastric grooves with a scutum (fig. 2). Epigyne as in fig. 3. Male smaller than female. Male palp as in fig. 5.

*Holotype :* One female, *paratype* two females and *allotype* one male in spirit.

*Type-locality :* Shillong Peak, Shillong, Assam, India. Coll. Shyamrup Biswas, 6.4.1967.

This species appears to be closely related to *Ischnothyreus omus* Suman described from Hawaii Islands. However, *Ischnothyreus shillongensis* differs from *I. omus* by the structure of the male palp and female epigyne. The dorsal scutum of *I. shillongensis* is smaller than that of




Figs. 1-5. *Ischnothyreus shillongensis* sp. nov.

1. Dorsal view of female, legs omitted ; 2. Lateral view of female, legs omitted ; 3. Epigyne ; 4. Lateral view of chelicera ; 5. Male palp.

*I. omus*. The cephalothorax of *I. shillongensis* is reddish-brown but in *I. omus* the cephalothorax has a pair of large brown patches behind the eyes.

ZOOLOGICAL SURVEY OF INDIA,
EASTERN REGIONAL STATION,
SHILLONG-4 (INDIA),
16 *December*, 1967.

B. K. TIKADER

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## 27. ON THE ABUNDANT OCCURRENCE OF *DESMOPTERUS GARDINERI* TESCH 1910, (THECOSOMATA: MOLLUSCA), IN THE INDIAN OCEAN

(*With a map*)

The genus *Desmopterus* was created by Chun in 1888 to include a single species *D. papilio*. This species is known to have a wide range of distribution from 35°N to 40°S latitudes in the Atlantic and Indian Oceans (Meisenheimer 1905; Tesch 1910, 1946).

Tesch added a new species, *D. gardineri* in 1910, based on a single specimen collected near the Chagos Archipelago (Map) during the Percy Sladen Trust Expedition (Tesch 1910). *D. gardineri* is distinguished from *D. papilio* by the form and arrangement of the muscle bands of the two fins. In both species the muscle bands run in two main directions, at right angles to one another. But in *D. gardineri*, the muscle bands are distinctly broader and clearly separated from one another, in contrast to *D. papilio*.

Since 1910, the only noteworthy collections reported on from the Indian Ocean are the Dana collections of 1928-30 Tesch (1946, 1948). He was unable to find examples of either species of *Desmopterus* in the Indian Ocean stations, and only one record of *D. papilio* from the Atlantic (*vide* p. 41, Tesch 1948). The present author has been unable to trace any published record of *D. gardineri* from the Indian Ocean or the other oceans of the world, since the date of original description.

The studies now in progress in the Indian Ocean Biological Centre, Ernakulam, (Kerala), on the Thecosomata (Opisthobranchiata, Order

Thecosomata: Mollusca) of the International Indian Ocean Expedition Collections, have revealed that both species of *Desmopterus* occur over wide areas of the Indian Ocean. Though *D. gardineri* is less abundant than *D. papilio*, it has been recognized in 32 stations out of the 395 stations examined so far (Cruises of *Argo* and *Anton Bruun*). It was identified in ten stations in the Bay of Bengal, five in the Arabian Sea and seventeen in the south-west region of the Indian Ocean as depicted in the Map, extending as far as 32°S latitude. Areas of relatively greater abundance may be mentioned as the central part of the Bay of Bengal, the east coast of Somalia and the north-west coast of Madagascar (Map). The number of specimens of *D. gardineri* estimated till now, totals 125 and the largest number from a single haul, (20 individuals) was in a station in the Bay of Bengal. A fuller account of the systematics, morphology and distribution of *Desmopterus* and other pelagic Thecosomata will be published elsewhere.

ACKNOWLEDGEMENTS

The author expresses his gratitude to Dr. N. K. Panikkar and Prof. John McGowan for encouragement and sincere thanks to Mr. L. R. Kasturirangan for offering suggestions.

INDIAN OCEAN BIOLOGICAL CENTRE,
NATIONAL INSTITUTE OF OCEANOGRAPHY, M. SAKTHIVEL
ERNAKULAM-6,
*September* 27, 1967.

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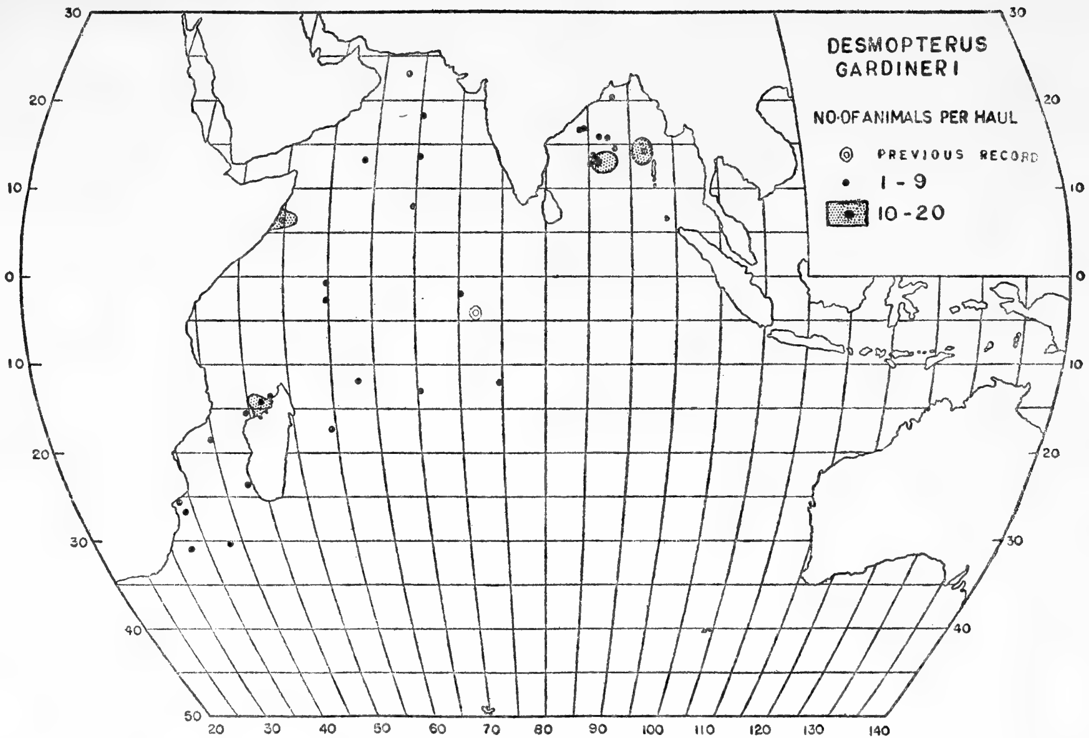
## 28. ADDITIONS TO THE FLORA OF BOMBAY

**Najas marina** Linn. Sp. Pl. 1015, 1753 incl. var. β et γ; Rendle, Trans. Linn. Soc. II, Bot. 5: 389, t. 39, f. 1-30, 1899; Hutchinson, Fam. Fl. Pl. 2: 561, f. 356—A-H, 1959; Duthie, Fl. Upper Gang. Plain 2: 376, 1960 (reprinted); Prain, Bengal Pl. 2: 847, 1963 (reprinted); de Wilde, Fl. Males. 6 (2): 163, 1962. *Najas major* All. Fl. Ped. 2: 221, 1785; Hook. f. Fl. Brit. India 6: 569, 1893; Haines, Bot. Bihar & Orissa 3: 892, 1961 (reprinted).




Distribution of *Desmopterus Gardineri*

Slender, dichotomously branched herbs rooting at lower nodes; internodes 1·5-4·0 cm. long, glabrous or with scattered spinous teeth. *Leaves* 10-15×0·7-1·0 mm., linear, flat, somewhat fleshy; apex blunt or acute; spinous teeth brown, 4-8 on each margin and a few on back; sheath 2·0-2·5×3·0-3·9 mm., with one to two inconspicuous teeth on each side. Spathe of male *flowers* 4·0×1·75 mm. *Anthers* 4-celled. Female *flowers* espathaceous, 1·9-3·9 mm. long. *Seeds* 2·5×1·5 mm. brown, elliptic, somewhat asymmetrical.

Occasional, in brackish water at Nal Sarovar, North Gujarat (*R.J.P.* without number, dated 1-2-1965) and in fresh water of Mahi River near Galteshwar, Central Gujarat (*M.H.P.* without number, dated December, 1966), mixed with *N. minor* All.

*Flowers and fruits:* December-February.

*Distribution:* Cosmopolitan, according to Duthie.

*Critical notes:* It differs from *N. minor* All. as follows (adapted from Prain):—

Dioecious; leaf teeth large, few, back of leaf and internodes with similar teeth; anthers 4-locular.............................. *N. marina*

Monoecious; leaf teeth rather numerous, back of leaf usually without teeth; anthers 1-locular.............................. *N. minor*

**Eupatorium odoratum** L. forma **squarrosum** Koster f. in Blumea 7 (1): 290, 1952.

Annual *herbs* 30-60 cm. tall, sometimes up to 90 cm. high; stem and branches terete, faintly striate, glabrous or sparsely hairy in older parts, thinly pubescent in younger. *Leaves* 4·0-6·0×0·8-2·5 cm., ovate-lanceolate, entire or slightly crenate, faintly three lobed near base, sparsely hairy and minutely gland dotted beneath, petiole 7·0-10·0 mm. long, with a few scattered hairs. *Heads* homogamous, 6·0-10·0 mm. long, cylindrical, in terminal corymbs. *Bracts* 3-5 seriate, those of inner series longest, 2·0-7·0×0·5-1·0 mm., linear glabrous but for appressed minute scales on back, prominently 3-5 nerved from base, nerves dark-green; apex obtuse or subacute; base rounded; margins entire, hairy in upper part. *Flowers* pale bluish-purple. *Pappus* uniseriate, scabridly hairy, as long as corolla. *Corolla* 4·5-6·0 mm. long. *Achenes* 2·0-3·0 mm. long, triquetrous, obconical, black, glabrous or sparsely hairy on angles.

The plant is a native of warmer parts of America, introduced as an ornamental hedge plant in V.P. College garden where it is now found wild (*Shah* 13048). In August 1966, one of us also found a few plants in the forests of Chhotaudepur, East Gujarat (*M.H.P.* without number), probably an escape.

*Flowers and fruits:* Mostly during monsoon, sometimes March-April.

**Trigonella uncata** Boiss. & Noë, Diagn. Ser. II 2 : 12.

Diffuse *herbs* 20·0-30·0 cm. long; stem and branches slender, glabrous, faintly striate. *Leaves* trifoliate, alternate; rachis 1·2-1·5 cm. long, hairy in younger parts, almost glabrous in older; leaflets 3, terminal one largest, all 2·0-4·0 × 1·3-3·0 mm., sessile or shortly petiolulate, obovate, inciso-serrate in upper half, glabrous above, appressedly hairy beneath, cuneate at base; stipules 3·0-4·0 mm. long, glabrous, deeply cut into 3-5 subbulate segments. *Flowers* yellow, 4-6, in axillary capitate racemes; peduncle 3·0-5·0 mm. long, sparsely hairy, ending in a sharp awn. *Pods* 5·6 × 1·5-2·0 mm., glabrous, linear, curved, shortly beaked. *Seeds* 4-6.

Rare; a small patch seen in sandy loam soil in Mahi River bed near Timba Road Station in Panchmahal District, East Gujarat (*M.H.P.* without number).

*Distribution :* Arabia, then ranging eastwards from Jordan, through Iraq, Iran, Baluchistan and N.W. India as a native. The present report, therefore, gives an additional locality of its distribution in India.

The authors are deeply thankful to The Director, Rijksherbarium, Leiden, for the identification of the first two plants and to The Director, Kew Gardens, England, for the identification and useful information on the distribution of the last plant.

DEPARTMENT OF BOTANY,
SARDAR PATEL UNIVERSITY,
VALLABH VIDYANAGAR,
GUJARAT STATE,
*May* 24, 1967.

G. L. SHAH
R. J. PATEL
M. H. PATEL

## 29. THE SPIRALITY OF MAIN STEM AND ITS RELATIONSHIP TO THAT OF OFF-SHOOTS IN *EUPHORBIA ANTIQUORUM* LINN.

(*With a text-figure*)

The stem of some euphorbiaceous species twists either clockwisely (left-handed) or counter-clockwisely. This twisting is easily perceivable in stems bearing one or more wings, grooves, rows of leaves or spines. This brief report shows how the twisting of the main stem and that of the first order of off-shoots in *Euphorbia antiquorum* are related. In this species, the stem is a succulent cladode which bears three or four wings, each wing possessing pairs of spines at intervals and small caducous leaves. In many varieties of *E. antiquorum* the stem does not show any twisting, but in one variety, very common in south India, twisting of the stem is clearly noticeable (Fig. 1). Data were collected in January 1965

from a population of this variety in a village near Coimbatore, south India.

Fig. 1. Right- and left-twisting stems of *Euphorbia antiquorum*

1,500 main stems were examined of which two per cent showed a reversal of the twisting from one type to the other. A fraction of these showed double reversals as seen in Table 1.

TABLE 1

*Euphorbia antiquorum* : NATURE OF MAIN STEM

| | |
|---|---|
| Left-handeds .. | 748 |
| Right-handeds .. | 722 |
| Left turning right .. | 20 |
| Right turning left .. | 7 |
| Left to right to left .. | 3 |
| Right to left to right .. | 0 |
| Total .. | 1,500 |

50·88 per cent of the regularly twisting stems were left-handers. A further 200 main stems were cut randomly from a further lot of plants. As mentioned, the stem has either three or four wings at the 'internodal' region. Out of the 200 plants, 58 had four wings each and the rest three. The stem may produce one branch each from a wing, and so a four-winged stem may have four off-shoots although in many they may be reduced to 3, 2, 1 or nil. Similarly, a three-winged stem may have less than four or no off-shoots. The few stems producing no off-shoot were excluded. Very rarely a wing produced more than one off-shoot. In Table 2 details of the off-shoots produced from the 200 main stems are given.

TABLE 2

*Euphorbia antiquorum* : NO. OF OFF-SHOOTS PER 'INTERNODE' (ALL WINGS) OF 200 MAIN STEMS

| Main stem | | Number of off-shoots | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 4-winged stems | | | | | 3-winged stems | | | | |
| Spiral | No. | 4 | 3 | 2 | 1 | Total | 4 | 3 | 2 | 1 | Total |
| Left | 117 | 22 | 10 | 5 | — | 37 | 1 | 51 | 24 | 4 | 80 |
| Right | 83 | 12 | 8 | — | 1 | 21 | — | 43 | 15 | 4 | 62 |
| Total | 200 | 34 | 18 | 5 | 1 | 58 | 1 | 94 | 39 | 8 | 142 |

Like the main stems, the off-shoots also showed asymmetry by twisting either clockwisely or conversely. A smaller percentage of these off-shoots, however, did not show any twisting and they were recorded as neutrals. From the 200 plants, 572 off-shoots were examined for their spirality and the data are given in Table 3.

TABLE 3

*Euphorbia antiquorum* : DIRECTION OF OFF-SHOOTS OF 200 PLANTS

| Main stem | OFF - SHOOTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Left: | | Right: | | Neutral: | | | |
| | observed | % | observed | % | observed | % | Total | % |
| Left | 243 | 71·26 | 72 | 21·11 | 26 | 7·62 | 341 | 100·00 |
| Right | 66 | 28·57 | 145 | 62·77 | 20 | 8·67 | 231 | 100·00 |
| L+R | 309 | 54·02 | 217 | 37·94 | 46 | 8·04 | 572 | 100·00 |

To find out whether there is a correlation between the kinds of twisting of the off-shoots and of the main stem, the observations were split up for the 4-winged shoots and 3-winged shoots and are presented in Table 4.

TABLE 4

*Euphorbia antiquorum* : ASYMMETRY OF OFF-SHOOTS IN RELATION TO MAIN STEM

| Spiral of main stem | off-shoots | Nature of off-shoots: Left | Right | Neutral | Total |
|---|---|---|---|---|---|
| | **4-winged off-shoots (Total 198)** | | | | |
| Left | observed .. | 100 | 16 | 12 | 128 |
| | percentage .. | 78·12 | 12·50 | 9.38 | 100·00 |
| | percentage on all shoots .. | 29·32 | 4·69 | 3·52 | 37·54 |
| Right | observed .. | 13 | 47 | 10 | 70 |
| | percentage .. | 18·57 | 67·14 | 14·28 | 100·00 |
| | percentage on all shoots .. | 5·63 | 20·35 | 4·33 | 30·30 |
| | **3-winged off-shoots (Total 374)** | | | | |
| Left | observed .. | 143 | 56 | 14 | 213 |
| | percentage .. | 67·14 | 26·29 | 6·57 | 100·00 |
| | percentage on all shoots .. | 41·94 | 16·42 | 4·11 | 62·46 |
| Right | observed .. | 53 | 98 | 10 | 161 |
| | percentage .. | 32·92 | 60·87 | 6·21 | 100·00 |
| | percentage on all shoots .. | 22·94 | 42·42 | 4·33 | 69-70 |

The expected values for all the groups have been calculated and given below :

| Main stem | | Off-shoots: L | R | N | Total |
|---|---|---|---|---|---|
| Left | observed .. | 243 | 72 | 26 | 341 |
| | expected .. | 183·212 | 129·365 | 27·423 | |
| Right | observed .. | 66 | 145 | 20 | 231 |
| | expected .. | 124·788 | 87·634 | 19·783 | |
| Total | .. | 309 | 217 | 46 | 572 |

$$x^2_2 = 109{\cdot}522$$

The value of $\chi^2$ is highly significant both at the 5% and 1% levels, which clearly demonstrates the positive dependence of the off-shoots on the main stems with regard to the type of twisting. Similar values for the data relating to the 4-winged stems and 3-winged stems as given in Table 4 were calculated and in each case, the $\chi^2$ value turns out to be highly significant even at the 1% level.

$$\text{4-winged off-shoots—}\chi^2 = 71\cdot314$$

$$\text{3-winged off-shoots—}\chi^2 = 147\cdot984$$

There is an interesting analogy to the above situation. In *Cordyline rubra* of Agavaceae, the leaves are arranged in two spirals, both of them running either clockwise or counter-clockwise in a shoot. The lamina is convolute in bud, rolling either clockwise or converse. In a shoot with right-handed foliar spiral, about 81 per cent of the leaves have right-handed convolution. In a left-spiralled shoot, on the other hand, the convolution in about a similar percentage is left-handed (Davis & Ghosh, in press). However, in *Dieffenbachia* sp., the foliar spiral and convolution of the lamina in a plant move oppositely. In *Pothos scandens*, a leaf of left convolution is generally followed by a leaf of right convolution, and rarely by one with involute rolling (Davis, in press).

Help received from Mr. Cyril Selvaraj of the Agricultural College. Coimbatore in collecting the data is gratefully acknowledged.

CROP SCIENCE UNIT,
INDIAN STATISTICAL INSTITUTE,
CALCUTTA-35,
*November* 20, 1967.

T. A. DAVIS

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## 30. NOTES ON *BOERHAVIA*

While visiting a local Municipal Hospital on 17 December 1966 I collected a *Boerhavia* growing on waste land in its compound. It attracted my attention for two reasons, it was extraordinarily tall (about 1 metre) and had conical fruits.

On careful examination in the Blatter Herbarium, the specimen matched with specimens of two species viz. *Boerhavia erecta* Linn. and *Boerhavia punarnava* Saha & Krishnamurthy. Our *B. punarnava* specimens have been collected from the type locality by Mr. B. Shrinivasan and *B. erecta* specimen were received in exchange from Dr. L. H. Shinners, Southern Methodist University, Dallas, Texas, U.S.A.

In order to confirm the specific identity of this erect *Boerhavia* from Bombay a duplicate herbarium specimen was sent to Dr. Shinners. He confirmed its identity as *Boerhavia erecta* Linn. and commented that it was an American weed and had perhaps found its way to India with food grain imports. He also directed my attention to its reference in the Flora of Java, Vol. 1 (1963) by C. A. Backer, and that Linnaeus, although he wished to honour the Dutch Botanist ' Boerhaave ', spelt it originally with only one *a*, explaining that he considered this to be better latin.

Dr. Shinners' remarks indicate that *Boerhavia punarnava* Saha & Krishm. and *Boerhavia erecta* L. are synonymous.

Blatter Herbarium also contains two specimens of this species (*Boerhavia erecta* L.) collected on 20 January 1958, by Dr. S. K. Wagh from Cuddapah (though identified as *Boerhavia crispa* Heyne).

This led us to examine further the Indian species of *Boerhavia*. We obtained *Boerhavia* collections from the various Indian herbaria on loan and I give below a key for the five Indian species which are very distinct.

KEY BASED ON THE CHARACTERS OF FRUITS :

A. Fruit with glands:........................................B
  - B. Fruit linear-oblong. Glands numerous along the 5-ridges..................................1 *B. chinensis*
  - B. Fruit club-shaped with only five glands forming crown at the top..............................2 *B. verticillata*

A. Fruits without glands:......................................C
  - C. Fruit obconical with five distinct ridges and furrows. Wrinkled................................3 *B. erecta*
  - C. Fruit ovate-oblong with five distinct ridges and furrows ..................................................D
    - D. Fruits glabrous. Pedicels glabrous, thin and elongated..............................4 *B. elegans*
    - D. Fruit pubescent, pedicels hairy and not elongated.... ....................................5 *B. diffusa*

KEY BASED ON VEGETATIVE AND FLORAL CHARACTERS :

A. Erect or semi-erect herbs. Inflorescence terminal or axillary panicles....................................1 *B. erecta*

A. Prostrate or scandent herbs. Inflorescence terminal or axillary panicles................................................B
  - B. Pedicels thin, elongated and glabrous........2 *B. elegans*
  - B. Pedicels pubescent, not elongated............3 *B. diffusa*

A. Scandent or climbing herbs. Inflorescence umbels or whorled racemes..........................................C

C. Flowers 3-8 in an umbel at the end of the peduncle..........................................4 *B. chinensis*

C. Flowers arranged in whorls on a peduncle..........................................5. *B. verticillata*

I have been unable to locate reliable herbarium specimens of the following two species:

1. *Boerhavia fruticosa* Dalz.
2. *Boerhavia crispa* Heyne

Herbarium specimens marked *Boerhavia fruticosa* Dalz. from Talbot's collection, received from Central National Herbarium, Calcutta, turned out to be *Siegesbekia orientalis* L. a composite.

*Boerhavia crispa* Heyne does not seem to be represented in any Indian herbarium, according to replies to our specific requests.

Blatter Herbarium,
St. Xavier's College,
Bombay-1,
*November* 30, 1967.

M. R. ALMEIDA

## 31. THREE NEW PLANT RECORDS FOR WEST BENGAL

During field collections undertaken in connection with ecological studies on the vegetation of West Bengal Coast, a few interesting plants were obtained, of which three were found to be new records.

**Cyperus arenarius** Retz. Obs. 4 : 9, 1786 ; Clarke in Hk. f. Fl. Brit. Ind. 6 : 602, 1893 ; Prain, Beng. Pl. 2 : 860, 1963 (repr. ed.).

A perennial rhizomatous sedge growing on sandy clay soil and sand-dune habitat at Digha and Higli. It is a sand binder sometimes found in association with *Indigofera glabra* Linn., *Gisekia pharnaceoides* Linn. and *Borreria articularis* (L.f.) F. N. Will. Its frequent occurrence shows that it is now more or less widespread in the coastal sandy areas of W. Bengal.

Digha : *A. K. Mukherjee and L. K. Banerjee* 4450, 24-8-1966 ; *T. A. Rao* 4087, 25-2-1965 ; Higli, *A. K. Mukherjee* 4491, 25-8-1966.

**Portulaca tuberosa** Roxb. (Hort. Beng. 91, 1814, nom. nud.) Fl. Ind. 2 : 464, 1832.

A perennial succulent herb with a fusiform root, and yellow flowers. The plant grew on moist sand at Digha coast ; hitherto it was not recorded from W. Bengal. The increasing frequency of its collection along the Indian coastal areas would seem to indicate that this species is now well established all along the coast.

Digha coast: *A. K. Mukherjee and L. K. Banerjee* 4454, 24-8-1966.

**Syzygium ruscifolium** (Willd.) Sant. & Wagh in Bull. bot. Surv. India 5: 109, 1963. *Myrtus ruscifolius* Willd. Sp. Pl. 2: 970, 1800. *Eugenia bracteata* Roxb. ex DC. Prodr. 3 : 264, 1828 ; Duthie in Hk. f. Fl. Brit. Ind. 2 : 502, 1879 ; Prain, Beng. Pl. 1 : 357, 1963 (repr. ed.).

A hardy perennial shrub, common in dry situations on sand-dune habitats, characterised by rusty-villous peduncles, white flowers and orange-red berries. It is common along the eastern side of Sagar Island growing in association with *Dodonaea viscosa* (Linn.) Jacq., and *Excoecaria agallocha* L. ; also found growing near inland sand dunes and sandy plains near Contai. In India it is reported from Sylhet, plains of south India, and also near the sea in Orissa. The occurrence of this plant in West Bengal at Sagar Island and Contai indicates the range of its distribution throughout West Bengal-Orissa coastal belt.

Sagar Island: Dhablat, *A. K. Mukherjee and L. K. Banerjee* 5914 April, 1967 ; Contai, *T. A. Rao* 4064 (a), 25-2-65.

BOTANICAL SURVEY OF INDIA, A. K. MUKHERJEE
CALCUTTA-14, L. K. BANERJEE
*September* 25, 1967.

## 32. TETRALOCULAR FRUITS IN *CLEISTANTHUS COLLINUS* (ROXB.) BENTH. EX HOOK. F.

(*With a photograph*)

The fruits in the genus *Cleistanthus* Hook. f. are described as trilocular by J. D. Hooker (Hook. f. in Hook. Ic. Pl. 8, t. 779, 1848) while erecting the genus on the basis of an African species, *Cleistanthus polystachyus* Hook. f. According to Pax & Hoffmann (Pflanzenfam. 19C : 34, 1931) the genus *Cleistanthus* Hook. f. is distinguished from *Bridelia* Willd., its closest ally, by its trilocular capsules and from the genus *Godefroya* Gagnep., another close ally, by the divided styles and trilocular capsules. In J. D. Hooker's FLORA OF BRITISH INDIA (5 : 274-282, 1887) all the species of *Cleistanthus* Hook. f. are described as having trilocular fruits except *C. ferrugineus* (Thwait.) Muell.-Arg. which is described as having tetralocular, rusty tomentose, capsules. It is a Ceylonese plant.

Tetralocular fruits in *Cleistanthus collinus* (Roxb.) Benth. ex Hook. f. have not been reported hitherto. There are no specimens of *C. collinus* (Roxb.) Benth. with tetralocular fruits either in the Madras Herbarium (MH) or in the Central National Herbarium (CAL). Specimens of

*Cleistanthus collinus* (Roxb.) Benth. ex Hook. f.—(*Subba Rao* 19787) collected from Cheedipalem, Visakhapatnam Dt., Andhra Pradesh and deposited in the Herbarium of the Southern Circle (MH), Coimbatore are noticed to have tetralocular glabrous capsules together with trilocular glabrous capsules (all tetralocular fruits deeply lobed) on the same plant (cf. photograph). This condition was observed on several trees of *Cleistanthus collinus* (Roxb.) Benth. in that locality.

Tetralocular fruits in *Cleistanthus collinus* (Roxb.) Benth. ex. Hook. f.

My thanks are due to the Director, Botanical Survey of India and Regional Botanist, Southern Circle, Botanical Survey of India for their kind encouragement and facilities provided and to the Keeper, Central National Herbarium for comparing the tetralocular specimens under reference with the specimens at Central National Herbarium.

SOUTHERN CIRCLE,
BOTANICAL SURVEY OF INDIA,
COIMBATORE,
*August* 1967.

G. R. KUMARI

## 33. ALGAE OF SIMLA

During a botanical excursion to north India, the author collected a few algae from Simla on 5 and 6 November, 1966. Simla is situated at 31°6′N., 77° 10′E. The altitude ranges from 2200 to 2450 metres. January is the coldest month with a mean temperature of 5°C and the mean temperature of June, the warmest month, is 20°C. The average rainfall for the whole year is 180 cm. The period of greatest rainfall is from June to October.

These algae have been collected from Simla, on way to the Glen, and from Mushobra, a place 10 km. away from Simla. Algae could be collected from a few places only as most of the collection spots like cataracts, dripping rocks, road side pools and puddles were dry. There was only one pond with an area of 15 sq. m. at Mushobra. This pond yielded 54 taxa belonging to 20 genera.

In this paper 78 taxa belonging to Chlorophyceae, Charophyceae, Xanthophyceae, Euglenophyceae and Cyanophyceae are recorded.

### CHLOROPHYCEAE

1. **Pandorina morum** (Muell.) Bory.
Rare. In a pond, Mushobra.

2. **Gloeocystis gigas** (Kuetz.) Lagerheim
In a pond, Mushobra.

3. **Pediastrum tetras** (Ehrenberg) Ralfs *v.* **tetraodon** (Corda) Rabenhorst
Very rare. In a pond, Mushobra.

4. **Coelastrum microporum** Naegeli
Common. In a pond, Mushobra.

5. **Trochiscia zachariasii** Lemm.
Common. In a pond, Mushobra.

6. **Scenedesmus bijuga** (Turp.) Lagerh. *v.* **alternans** (Reinsch) Hansgirg
Common. In a pond, Mushobra.

7. **S. brasiliensis** Bohlin.
Rare. In a pond, Mushobra.

8. **S. denticulatus** Lagerheim
Planktonic in a reservoir, Simla.

9. **S. dimorphus** (Turp.) Kuetzing
In a pond, Mushobra.

10. **Ankistrodesmus falcatus** (Corda) Ralfs
Rare. In a pond, Mushobra.

11. **Selenastrum westii** G. M. Smith
Rare. In a pond, Mushobra.

12. **Botryococcus sudeticus** Lemmermann
In a reservoir, Simla.

13. **Stigeoclonium tenue** (Agardh) Kuetzing
Attached to water pipes in a reservoir, Simla.

14. **Protococcus viridis** C. A. Agardh
On moist earthen walls of houses, Mushobra.

15. **Cladophora glomerata** (L.) Kuetz.
Attached to sticks, stones in a reservoir, Simla.

16. **Oedogonium nanum** Wittock. Tiffany
Epiphytic on *Cladophora* filaments in a water reservoir, Simla. Only female filaments were observed.

17. **Cylindrocystis brebissonii** Menegh.
In a pool, Glen, Simla.

18. **Pleurotaenium ehrenbergii** (Bréb.) De Bery
Rare. In a pond, Mushobra.

19. **Closterium acerosum** (Schrank) Ehrenberg
In a pond, Mushobra.

20. **C. dinae** Ehrenberg.
In a pond, Mushobra.

21. **C. dinae** Ehrenberg *v.* **arcuatum** (Bréb.) Rabenhorst
In a pond, Mushobra.

22. **C. idiosporum** W. et G. S. West
In a pond, Mushobra.

23. **C. kuetzingii** Bréb.
In a pond, Mushobra.

24. **C. leibleinii** Kuetzing
In a pond, Mushobra.
Cells much shorter (up to 100 $\mu$ long).

25. **C. rectimarginatum** Scott et Prescott v. **maius** Kamat
In a pond, Mushobra.

26. **C. venus** (Kuetzing) Brébisson
In a pond, Mushobra.

27. **Cosmarium abbreviatum** Racib. f. **pygmaeum** Missik.
In a pond, Mushobra.

28. **C. laeve** Rabenhorst
In a pond, Mushobra.

29. **C. meneghinii** Bréb.
In a pond, Mushobra.

30. **C. punctulatum** Bréb. v. **rotundatum** Klebs
Submerged mucilaginous masses in a reservoir, Glen, Simla.

31. **C. regnellii** Wille
Abundant. In a pond, Mushobra.

32. **C. regnesi** Reinsch
In a pond, Mushobra.

33. **C. subretusiforme** W. et. G. S. West v. **maiums** Kamat
In a pond, Mushobra.

34. **C. succisum** West v. **hyalinum** Skvortzow
In a pond, Mushobra.

35. **C. undulatum** Corda v. **minutum** Wittrock
In a pond, Mushobra.

36. **Euastrum verrucosum** Ehrenberg
In a pond, Mushobra.

37. **Staurastrum dickiei** Ralfs
In a pond, Mushobra.

38. **S. muticum** Brébisson
In a pond, Mushobra.

39. **S. orbiculare** Ralfs v. **depressum** Roy et Bisset
Common. In a pond, Mushobra.

40. **Sphaerozosma granulatum** Roy et Bisset
In a pond, Mushobra.

### Charophyceae

41. **Chara corallina** Willd.
Abundant in a pond, Mushobra. Plants comparatively far more delicate than those found in Maharashtra State. Mosquito larvae were present in abundance very close to these plants.

### Xanthophyceae

42. **Tribonema bombycinum** (C. A. Agardh) Derbes et Solier
In a streamlet, Simla. On dripping rocks, Mushobra.

43. **Vaucheria sessilis** (Vauch.) De Condolle
Common. On shaded moist soil, slopes, Simla, Mushobra.

### Euglenophyceae

44. **Euglena oxyuris** Schmarda
Common. In a pond, Mushobra.

45. **E. sanguinea** Ehrenberg
In a pond, Mushobra.

46. **E. spirogyra** Ehrenberg v, **abrupte-acuminata** Lemmermann
In a pond, Mushobra.

47. **Phacus curvicauda** Swirenko
In a pond, Mushobra.

48. **P. orbicularis** Hübner
In a reservoir, Glen, Simla.

49. **P. polytrophos** Pochmann
In a pond, Mushobra.

50. **P. triqueter** (E.) Duj.
In a pond, Mushobra.

51. **P. unguis** Pochmann
In a pond, Mushobra.

52. **Trachelomonas cylindrica** E. sec. Playfair
In a puddle, Glen, Simla.

53. **T. dybowskii** Drez.
In a pond, Mushobra.

54. **T. hispida** (Perty) Stein emend. Deflandre
In a pond, Mushobra.

55. **T. subverrucosa** Deflandre
In a pond, Mushobra.

56. **T. volvocina** Ehrenberg
In a pond, Mushobra.

CYANOPHYCEAE

57. **Aphanothece castagnei** (Bréb.) Rabenhorst
On moist soil, on bark of trees, Simla, Mushobra.

58. **A. microscopica** Naegeli
On dripping rocks, Mushobra.

59. **Merismopedia elegans** A. Br.
In a pond, Mushobra.

60. **M. punctata** Meyem
In a pond, Mushobra.

61. **Oscillatoria corakiana** Playfair v. **nongranulata** Kamat
In a pond, Mushobra.

62. **O. formosa** Bory ex Gomont
In gutters, Glen, Simla.

63. **O. mougeotii** Kuetzing
Forming a dark blue-green layer on submerged soil in a pond, Mushobra.

64. **O. prolifica** (Grev.) Gomont
In a pond, Mushobra.

65. **O. proteus** Skuja
On moist soil near the pond, Mushobra.

66. **O. pseudogeminata** G. Schmid
In a pond, Mushobra. In the mucilaginous masses of other algae, Simla.

67. **O. quadripunctulata** Brühl et Biswas *v.* **unigranulata** R. N. Singh *f.* **ahmedabadensis** Kamat

In a pond, Mushobra.

68. **O. rubescens** DC. ex Gomont

Common in gutters, Simla.

On wet bricks, Mushobra.

69. **O. tenuis** Ag.

Common. In a pond, Mushobra.

70. **Lyngbya allorgei** Fremy

Adhering to submerged iron pipes, Glen, Simla. On moist soil, Simla.

The filaments are slightly broader (up to 4·35 $\mu$ broad) than those in the type.

71. **L. antarctica** Gain

Cement gutters, Simla.

72. **L. lachneri** (Zimmermann) Geitler

Adhering to submerged iron pipes, Glen, Simla.

In cement gutters, Simla.

73. **L. martensiana** Meneghini

Adhering to submerged iron pipes, Simla.

74. **L. nordgardhii** Wille

Embedded in mucilaginous masses of *Aphanothece*, Simla.

75. **Microcoleus vaginatus** (Vauch.) Gomont v. **vaucheri** (Kuetz.) Gomont

On moist soil, Simla.

76. **Schizothrix pallida** (Naegeli) Geitler

Thallus woolly, reddish brown ; filaments curved, branched, 22-30-50 $\mu$ broad, sheath yellowish brown to reddish brown, distinctly stratified, at the ends pointed, outside even, with 1-4 trichomes, coloured violet by chlor-zinc-iodide ; trichomes not constricted at the cross-walls, blue-green, not tapering at the ends, cells 9-9·6 $\mu$ broad, 7-8 $\mu$ long, end cell bluntly conical.

On dripping rocks, Mushobra.

77. **Cylindrospermum musicola** Kuetzing ex Born. et Flah.
Blue-green mucilaginous masses on slopes, Glen, Simla.

78. **C. stagnale** (Kuetz.) Born. et Flah.
On moist soil, Glen, Simla.

BOTANY DEPARTMENT,
COLLEGE OF SCIENCE,
NAGPUR,
*April* 12, 1967.

N. D. KAMAT

# Gleanings

## Elephant Birth

KYH Magazine, published by the Shikar-Safari Club (11681 San Vincente Blvd., Los Angeles, Calif. 90049) carries in its Winter 1966 Conservation Issue an interesting account by Salvation Army Brigadier Young of an elephant birth witnessed by him in Kruger National Park. The expectant mother with the 'birth bag' already protruding from her vagina and with a young female in attendance was about 200 yards away from the rest of the herd. Groaning loudly while she laboured she busily churned up the soil into a large patch of loose sand. Within five to ten minutes the first twin dropped, covered with 'white/yellowish mucus and blood.' While the baby lay still the mother cleaned off the mucus and blood by squirting it with the sand. In another 20 minutes or so the second twin arrived, and was cleaned in like manner. Meanwhile, the attendant female circled around keeping off the vultures which had quickly gathered. Shortly thereafter the young ones got up on their feet, unsteady and stumbling at first and requiring the mother's help. Finally, with the babies under her and trying to suck, the mother cleaned herself with the useful sand.

*Karatasi Yenye Habari*, Winter 1966, Conservation Issue, p. 40.

## Behaviour Patterns of Onagers

In a paper based on observation of Onagers in the Badkhyz Reserve in south-eastern Turkmenia extending over a period of three years, A. O. Solomatin reports the interesting fact that lactating females avoid water of a salinity exceeding 10 grammes per litre. The important watering places for Onagers are freshwater basins. In summer the feeding grounds are generally within 10 to 15 kilometres of their water supply; this limit may extend to as much as 20 to 30 kilometres in Autumn, and even more later.

A. O. Solomatin: Visitations of Sources by Onagers and Behavioural Patterns on the Watering Places. 1967, *Bulletin of Moscow Society of Naturalists*. Biological Series, Vol. **72** (4), pages 25-35.

### An unusual mammal breeding pattern

Experimenting with a pair of tree shrews from south-east Asia, Robert Martin, of the Zoology Department, Oxford, has discovered an unusual breeding pattern. Two nests are used; the mother and her mate occupy one, while the young ones are left unattended in the other from birth the mother visiting them for a few minutes just after dawn every second day for one month to feed them. Owing to this discovery he has been able to breed successfully from them in Oxford. As the mother continues to feed the young ones even after they have been handled by humans, this discovery opens up many possibilities for laboratory purposes.

P. D. Rodgers: The Rearing of the Shrew. *New Scientist*, 30 March 1967, **33** (538) :661.

### Insect Control by Use of Sex Pheromones

Lyle K. Gaston and others of the Department of Entomology, University of California, report a first success in the use of artificial-sex-phermone concentration to inhibit orientation in mate-seeking insects. The experiment was carried out over six nights with ten virgin female cabbage looper moths (*Trichoplusia ni*) in a trap at the centre of a 'pheromone-baited' area, the site of which was varied at random every second night. Whereas in the control area 600 metres away, the site of which was similarly varied every second night, 102 males were caught, no male was caught in the 'pheromone-baited' area. Experiments are in progress to determine the minimum concentration of pheromone necessary to inhibit male-to-female orientation.

Lyle K. Gaston, H. H. Shorey, and C. A. Saario: Insect Population Control by the Use of Sex Pheromones to inhibit Orientation between the Sexes. *Nature*, 18 March 1967, Vol. **213**, No. 5081, p.1155.

### The States of Sleep

In a paper dealing with the states of wakefulness and sleep in cats Michel Jouvet divides sleep into light sleep and what he calls paradoxical sleep. In light sleep the muscles retain some tension and the cat is easily wakened. After ten to twenty minutes of light sleep there follows paradoxical sleep, which is marked by complete relaxation of the muscles and is not readily disturbed; the name is explained by the fact that this state is associated with movements

of the eye and other parts of the body and with cortical activity, such as are generally associated with a state of wakefulness. The author discusses the processes and structures involved and puts forward the hypothesis that the raphe system in the brain stem is responsible for light sleep and operates through serotonin, and that the control for paradoxical sleep operates through adrenalin and is located in the locus coeruleus lower down the brain stem. Round-the-clock recordings have shown that cats spend about 35% of the time in a state of wakefulness, 50% in light sleep, and 15% in paradoxical sleep. Systematic examination in the laboratory suggests that paradoxical sleep does not occur in the lower animals, for example the reptiles, and rises in the scale through birds and the lower mammals to the higher mammals; hunting species seem to enjoy a higher proportion of paradoxical sleep as compared to total sleep than do the hunted species.

1967, Michel Jouvet: The States of Sleep. *Scientific American.* Vol. **216**, No. 2, pp. 62-72.

**Co-operative Bird Ringing**

In the hope of inducing readers elsewhere to get together and form small bird-ringing groups, to co-operate with work being done at Bird Observatories and to provide individual ornithologists with opportunities for original work that they would not otherwise have had, B. S. Nau describes in a stimulating paper the origin and development of the Rye Meads Ringing Group and mentions some of its achievements during its short existence of about ten years. The group must be small enough for the individual members to keep personal touch with each other and yet large enough for work to proceed continuously; about thirty seems to be a suitable number. Ringing will be confined to a restricted area and careful records kept in rather more detail than is usual. It is not sufficient to keep the records; they must be studied within the group. Mr. Nau discusses how the necessary enthusiasm for the successful launching and running of such a group can be worked up.

1967, B. S. Nau: Co-operative bird ringing. *Bird Study,* Vol. **14**, No. 1, pp. 1-9.

# Notes and News

## Field Work Grant

Arising out of a donation made by Mr. Humayun Abdulali, the Society has at its disposal Rs. 1200 for assisting naturalists, amateur or professional, engaged in field studies (including collecting trips) preferably in vertebrate zoology. Applications, giving particulars of the work proposed and the extent of the assistance required, are invited. Applications should be addressed to the Honorary Secretary, Bombay Natural History Society, Hornbill House, Bombay 1-BR.

## Book of Indian Birds—Eighth Edition

For over two decades the BOOK OF INDIAN BIRDS by Sálim Ali has remained an indispensable field guide for every one who wishes to enjoy the rich and varied bird life of the sub-continent. The eighth edition, now in press, retains all the features of its immediate predecessor and in addition describes and illustrates eight more birds bringing the number of species of the commoner birds of the plains, foothills, inland waters, and the sea-coast, described and illustrated, to 264. Copies will be available by mid-1968.

# Announcement

## DIPLOMA IN RESOURCES ECOLOGY

Banaras Hindu University, India announce the institution of a one-year Diploma course in Resources Ecology with effect from August 1968. The course is designed to train prospective and in-service personnel engaged in landscape and range management, utilization and management of biological and other resources, and nature conservation. The Institute will serve as the International Centre for Training in Resources Ecology.

The duration of the course shall be two semesters. The candidates must hold a B.Sc. (Pass or Honours) degree with any of the two following subjects: Botany, Zoology, Geography and Geology.

The details of the course can be had from Professor R. Misra, Chairman, International Committee for Education and Training in Resources Ecology, and Head of the Department of Botany, Banaras Hindu University, Varanasi-5, India, to whom the applications for admission must reach before July 15, 1968.

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# JOURNAL
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# The Ecology of the Lion-tailed Macaque [*Macaca silenus* (Linnaeus)]—A Pilot Study


BY

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(*With two plates, a map, and a text-figure*)

## INTRODUCTION

The Lion-tailed Macaque (*Macaca silenus*) is a medium-sized macaque. An average adult male weighs 6·8 kg. in body weight, and 52 cm. in head-and-body length, and 35 cm. tail length, and female 46 cm. in head-and-body length and 27 cm. in tail length (Blanford 1888, Napier & Napier 1967). Owing to its unique dark grey or brownish grey whisker or ruff, and black coat it was sometimes separated from the genus *Macaca* (Sanderson 1957).

This pilot study was undertaken to investigate the present distribution of the species, its ecology and social organisation in the natural habitat. Though the data obtained were few owing to the shortness of the study period and the difficulty of observation of this animal, the author presents them as the study of lion-tailed macaques has not progressed since the time of his survey, in spite of many efforts. The field work was divided into two parts ; 10 days in September, 1961, and 1 month in February, 1962, on the distribution survey trip[1] and 2 months between January 5 and February 27, 1963, on a rather intensive field study.

[1] The distribution survey trips were made with Dr. S. Kawamura, Dr. M. D. Parthasarathy and Mr. K. Yoshiba, members of the Japan-India Joint Project in Primates Investigation.

## Distribution and Population

It is said that lion-tailed macaques occur from 14°N to the southern limit of the Western Ghat Mountains in south-west India (Blanford 1888). But hunting for their meat and beautiful coat or fur has considerably reduced their distributional range.

The author and his colleagues saw populations of lion-tailed macaques in only 4 regions namely, Nilgiri Hills, Anaimalai Hills, Cardamom Hills and in the vicinity of Periyar Lake. They are restricted to mountain ranges between 800 m. and 1300 m. in height lying between 9° 30′ and 11° 30′ N (Map). The habitat is mainly evergreen or semi-evergreen forest of more than 20 m. high trees. No information on populations north of 11° 30′ N was obtained. Judging from the vegetation type of the present habitat of this species, there may be no lion-tailed macaques except in the above mentioned regions and a few regions which the author could not visit. Even in these regions the population of lion-tailed monkeys is very small.

Estimating from the impression of the author's survey, the wild population of this species is less than 1000 head and there is the possibility that the wild population of lion-tailed macaques will become extinct.

## Study Area and Home Range of Troops

Observations on wild lion-tailed macaques were made at Panniar, High Range, Kerala State, on the western face of the ridge which marks the State border of Kerala and Madras. The area has steep hills covered by evergreen forests of trees about 30 m. high with planted cardamom (*Elettaria cardamomum*) on the forest floor (Plates I & II). The field work was frequently disturbed by wild elephants, snakes and leeches.

In the centre of the study area, two troops of lion-tailed macaques lived and had overlapping home ranges. No other troop of this species was seen in the area. There may have been some small populations of the species but the author saw only these two troops in the Cardamom Hills. Other than the troops, some solitary males were observed in the study area and nearby forests.

The home ranges of the troops during the study period were about 2 km. each (Text-fig.).

## Troop organization and intertroop relationship

Troop sizes were 16 and 22 as shown in Table 1. Both troops had more than one adult male and adult female each, and had adolescent animals of several generations. The sex ratio, of adult male to adult female, was 0·375 and 0·363.

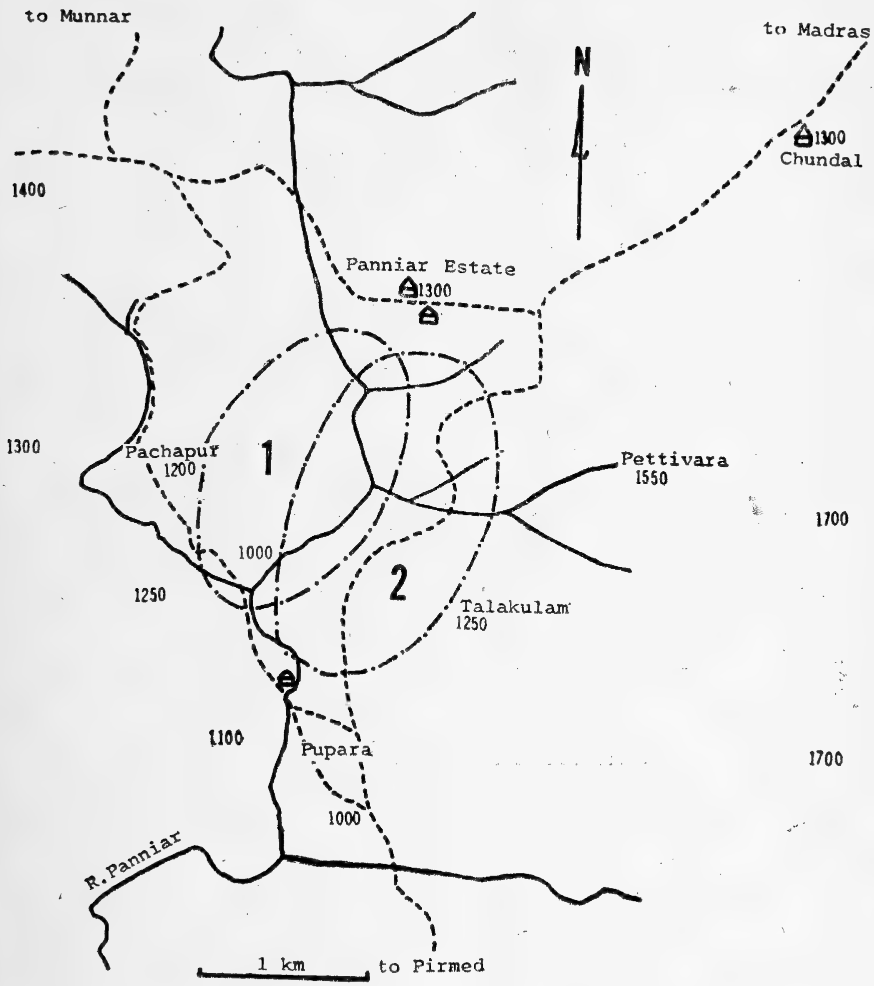
The Panniar forest. The Panniar River lies in the centre of the photograph and the high mountain is covered by grassland and *shola*.

(*Photo : Author*)

Interior of the Panniar forest is gloomy even in the daytime.

*(Photo : Author)*

Large adult males led in each troop. It was noted that an adult male kept at some distance ahead of the others when the troop was




Home Ranges of Troops 1 & 2 in the Panniar Area

Chair circles show home ranges and numbers (1000-1700) altitude in metres

travelling and adult males were in the lead and in the rear when the troop was moving fast (Table 2). As the overlapping part of the ranges of the two troops had many food trees during the study period both troops frequently came to them, and contact between the two troops was observed many times. They were antagonistic and troop 2 was dominant. When they came near, large adult males in each troop displayed by whooping loudly but no direct fighting was seen. Usually, troop 1 moved away after a short time of vocalization. Occasionally both

troops stayed near for a long time without trouble among peripheral animals.

TABLE 1

COMPOSITION OF LION-TAILED MACAQUE TROOPS

| Age-sex class | Full grown adult ♂ | Sub-adult ♂ | Full grown adult ♀ | Sub-adult ♀ | Juvenile | Infant | Baby | Total |
|---|---|---|---|---|---|---|---|---|
| Estimated age | >6 | 4-6 | >6 | 4-6 | 2-4 | 0·5-2 | <0·5yr. | |
| Troop 1 | 2 | 1* | 7 | 1* | 3 | 2 | 0 | 16 |
| Troop 2 | 2 | 2 | 10 | 1 | 4 | 0 | 3 | 22 |

* Killed by hunters during the study period.

Though, usually members of a troop travelled together, sometimes some members of a troop temporarily moved away from the main group. Troop 1 occasionally divided into two, each containing about half the number and with adult males in both. Unfortunately I could not determine whether or not a subgroup had the same animals on different occasions. Mating couples were often observed more than 100 or 200 m. from their troop. Temporary division of a troop is rarely seen in macaque troops, although a subordinate male and its spouse commonly mate at a place where no other member of the troop can observe them (Itani & Tokuda 1958, on *M. fuscata* and Sugiyama, unpublished, on

TABLE 2

SOME EXAMPLES OF PROCESSION ORDER

| Troop | Date/Time | Order | Remarks |
|---|---|---|---|
| 1 | Feb. 25, 10 . 00 | FA♀, FA♀, FA♀, *FA♂*, FA♀+Inf, FA♀ FA♀ Juv, Juv, Juv, FA♀, *FA♂* | An infant was mis-recorded. |
| 1 | Feb. 25, 14 . 20 | *FA♂*, FA♀, FA♀, FA♀+Inf, FA♀, Juv, Juv, FA♀, FA♀, Juv, FA♀+Inf. *FA♂*. | |
| 2 | Feb. 12, 10 . 33 | *FA♂*, FA♀, FA♀, YA♀, *FA♂*, YA♂, A♀?, Juv?, A♀?, Juv?, FA♀, FA♀+Bab, FA♀, Juv, FA♀+Bab, Juv, FA♀+Bab, FA♀, YA♂? | |
| 2 | Feb. 26, 11 . 30 | FA♀+Bab, FA♀+Bab, Juv, FA♀, *FA♂*, Juv, FA♀, YA♀?, YA♂, FA♀?, FA♀, FA♀, Juv, Juv, FA♀, FA♀, *FA♂*, FA♀+Bab, YA♂. | |

*M. radiata*). In lion-tailed macaque, males of mating couples which move away from the troop were not large and might be subordinate ones.

A few animals that had noticeable characters were identified from others and some data on the permanent social relation among troop members were obtained.

## Feeding behaviour

The only important food for lion-tailed macaque during the study period was a kind of chestnut-like fruit (species unknown), from one of the dominant trees in the forest. After picking an unripe ' chestnut ', they cracked it with the teeth and fingers spending about ten or more minutes on this, before eating. In addition to this fruit, they ate other fruits, nuts, flowers and young buds of many kinds of trees, insect larvae living under tree-bark, pith of cardamom stem and so on.

## Movement

Lion-tailed macaques were very shy and moved to the top of high trees whenever the author was observing them. However, if he hid behind a tree or rock they sometimes came down to the ground and marks of feeding were also seen on the ground. They travelled through trees even when undisturbed and mainly stayed on trees when feeding and resting. Generally macaques travel long distances on the ground, though some usually stay on the tree when they feed or rest. Lion-tailed macaques apparently are more arboreal than most other macaques in the natural habitat.

## Vocal Communication

The whooping display is divided into several emphatic phases and, in this point, resembles the whooping of the Nilgiri Langur (*Presbytis johnii*). Whooping as a threat display is common in the gibbon (*Hylobates*) (Carpenter 1940), the langur (*Presbytis*) (Sugiyama *et al.* 1965) and the howling monkey (*Alouatta*) (Carpenter 1934) but is rare among macaques. This kind of vocalization was uttered as a threat against a kite flying overhead as well as threat display against the neighbouring troop. Vocalization was mainly by adult males but a rather defensive one was uttered against the author by an adult female. I was struck by the resemblance of the whooping call to human vocalization and once when I imitated the call from behind a tree, a large adult male was deceived and looked around as if he was searching for an enemy or competitor.

When lion-tailed macaques feed or rest undisturbed and scattered through the forest, members keep in touch by a muttering or murmuring

call [It corresponds to A-1 of the vocal list of *M. fuscata* (Itani 1963)]. This was also copied by the author and replied by animals. Call and response were continued for nearly one hour when he was discovered by an animal.

Ten kinds of vocalization were classified ; alert, threat or attack against a troop member, whooping display (mentioned above), female's scream, juvenile's scream, infant's squeal, long distance communication between troop members during travel, short distance communication (mentioned above), male's call during sexual excitement and female's love call. There may be some more kinds of vocal communication.

## Breeding Activity

On 12 occasions between January 14 and February 26 sexual behaviour or œstrous females were observed. These were extensive mutual grooming, embracing by the mating couple, love call by an œstrous female to a male, male's examination of the vulva of an œstrous female etc. As mentioned earlier, many mating couples were found far from their troop. Four copulations were observed on January 14, February 13, 16 and 21. The copulatory behaviour was similar to that of other macaques (Tokuda 1961-62). The sexual skin surrounding the anus and vulva of an œstrous female may or may not be swollen.

Table 3

Estimated Birth Date of New-born Babies

| Estimated birth date | Found on |
|---|---|
| Jan. 1-5 | Jan. 8 |
| Jan. 18 | Jan. 18 |
| Jan. 25-31 | Jan. 31 |

During the study period, 3 new-born babies were seen (Table 3). The new-born baby has brown hair and pale-pink skin. One month after birth, the skin becomes pale-brown and gradually darkens the hair finally turns black, and only the whisker or ruff remains brown or grey.

Combining the data of sexual activity and birth, though the inference is limited to data from two months' observations, it appears that there is no restricted mating season in the lion-tailed monkey.

## Interspecies Relationship

The higher hills of over 1500 m. to the east and north of the study area had, only grasslands and shola forests (Plate I). The shola forests held a large population of the Nilgiri langur (See Tanaka 1965,

for Nilgiri langur, and Poirier 1968, for shola forests). The lion-tailed macaques did not react to the loud whooping of the Nilgiri langurs. Sometimes mating couples and solitary Nilgiri langurs wandered into the range of the lion-tailed monkey. Two of them followed the troops of lion-tailed monkeys but the latter were not aggressive. The Nilgiri langur is similar in colour except for the head.

In the study area bonnet macaques (*Macaca radiata*) lived within the range of lion-tailed macaques troops. Smaller in size but with a larger troop size (about 30 head) the bonnet macaque is more terrestrial and is commoner in dry deciduous forests and the vicinity of the villages in drier areas. In the study area it was as arboreal as the lion-tailed macaques. Troops of both species were not overtly antagonistic. A troop of bonnet macaque moved among lion-tailed macaques and sometimes even travelled following the latter. Lion-tailed macaques usually did not react to the appearance of bonnet macaques but sometimes moved away slowly from them. Although smaller, bonnet macaques were dominant.

A similar interspecies relation existed between the bonnet macaque and the Hanuman Langur (*Presbytis entellus*) in the dry-deciduous forests and roadsides of Dharwar, Mysore State (Sugiyama 1967). The Hanuman langur eats far more leaves than fruits, and bonnet macaque more of fruits and insects. In the study area the food habits of the bonnet macaque and the lion-tailed macaque were nearly the same.

## Human Influence

Though a native tribe of the Nilgiri Hills, Nyakanmar, catch and eat monkeys (Kawamura, paper presented at Primates Research Conference, 1964) the tribals, Muduvans, in the study area, do not harm them, but hunters from elsewhere come to kill lion-tailed macaques. During the study period, a young adult male and a young adult female that might have separated from troop 1 were shot by hunters on January 24, 1963. Human persecution has made them extremely wary and shy in their natural habitat.

Tigers (*Panthera tigris*) and leopards (*Panthera pardus*) may be potential predators of the lion-tailed macaque but their influence on its wild population must be negligible.

## Discussion

In most parts of India monkeys maintain high population in their natural habitat without much fear of man and field study of monkeys are easier in India than in any other country. The lion-tailed macaque is, however, constantly harassed and has become very shy and has taken to living in high forests. For saving the wild population of this beautiful

monkey from extermination, special and strong methods of preservation are necessary.

In general appearance the lion-tailed macaque differs from other macaques. However, though troop size is smaller and the sex ratio, adult male/adult female, lower than in some other kinds of macaques, the social organization and most of the behaviour patterns of lion-tailed macaque troops resemble other macaque societies (Kawai 1964, on *M. fuscata* ; Southwick & Siddiqi 1966, on *M. Mulatta* ; Sugiyama 1963, and Simonds 1965 on *M. radiata*).

The lion-tailed macaque is more arboreal than other macaques. However, even bonnet macaque, that are rather terrestrial in drier areas, were arboreal in the study area. Arboreal-terrestrial ratio as a species specific character must be largely modified by adaptation to the environment. The restriction of the present habitat of the species to high and dense forest, is perhaps related to the influence of human agency.

It was suspected that there is no restricted mating season in lion-tailed macaques of the study area and, if it is correct, it is similar to the sexual seasonality of the Hanuman langur (Jay 1963 ; Sugiyama *et al.* 1965) and the bonnet macaque (Simonds 1965 ; Sugiyama, unpublished) of the Deccan Plateau. There must be similar environmental influences on sexual activity.

There is little evidence of permanent subgroup organization as in troops of other macaques in a stable situation. Separation movements of some animals from a troop of lion-tailed monkeys which the author observed might be the beginning of subgroup formation similar to the first stage of the troop division that is seen in the Japanese monkey, *M. fuscata* (Sugiyama 1960). On this point more intensive observations on the social organization of the lion-tailed macaque are necessary.

Vocal intimidation between neighbouring troops, using whooping display is rarely seen in macaques. Neighbouring troops of Japanese monkeys and bonnet macaque usually keep away from each other and avoid direct contact, and so in the vocal list of macaques the whoop-like vocalization is absent. It is interesting that the whooping of lion-tailed macaque is similar to that of the Nilgiri langur belonging to a separate subfamily that lives in the same habitat as the lion-tailed macaque at Panniar. Resemblance in the body colour of the lion-tailed macaque and the Nilgiri langur is also important. Native people who frequently work in the forest distinguish one from another, but other people quite often do not know that there are two kinds of 'black monkeys with brown whisker' in their forest. Similar resemblance can be seen in the general appearance of the black ape (*Cynopithecus niger*) and the moor monkey (*M. maurus*). Are these resemblances the result of adaptation to the same or similar environment?

Similar to the interspecies relation between the Hanuman langur and

the bonnet macaque that belong to separate sub-families, the Colobinae and Cercopithecinae, that of the lion-tailed and bonnet macaque belonging to the same genus and having allied feeding habits was little antagonistic, though two neighbouring troops of the same species were antagonistic. This means that antagonism between troops may not necessarily occur from competition for the same food spread throughout the forests, but may be due to other common forces also ; for example, sexual desire. Two males of different species need not fight for a female as they are not competitors on this matter, and minor interspecies difference in behaviour patterns and action-reaction system which release fear or anger may not fully raise the excitement of an animal of another species. In African forests closely allied species live in harmony in the same habitat, same range, same layer and even same branch of a tree (Haddow 1952-53). The explanation for coexistence of closely related primate species is not differences in feeding habits alone.

As discussed above the lion-tailed macaque has many common characters with other kinds of macaques on one hand and some common characters with some species of different genera on the other. For answers on the phylogenetical relationship with other species of macaques and the ecological relationship with other primate species living in India, the ecology and social habits of the lion-tailed macaque in its natural habitat must be studied more extensively and intensively.

## Summary

The present distribution range and the wild population of the lion-tailed macaque is very small and their extermination is likely unless strong action for preservation is taken. Two troops of lion-tailed macaques of Panniar forest, High Range, Kerala State, were antagonistic to each other but their home ranges overlapped. Troop size, composition and organization showed the standard type for macaques but vocal intimidation between neighbouring troops by whooping display was characteristic. In January and February sexual behaviour as well as birth of new babies were observed and no limited mating season was believed to exist.

In the same range there were troops of bonnet monkeys which were dominant but the two species were not very antagonistic. In the higher mountains close to the range of lion-tailed monkeys there were Nilgiri langurs whose body colour is close to that of the lion-tailed macaque. Lion-tailed macaques were not aggressive to solitary Nilgiri langurs who wandered in its range.

## Acknowledgements

The data on the distribution of the lion-tailed macaque were given by the Bombay Natural History Society and its members. Mr. J. C. Scott, Mr. P. G. S. Hall, Mr. M. George and many persons gave me their help at the study areas. I would like to extend my thanks to these persons and the organization.

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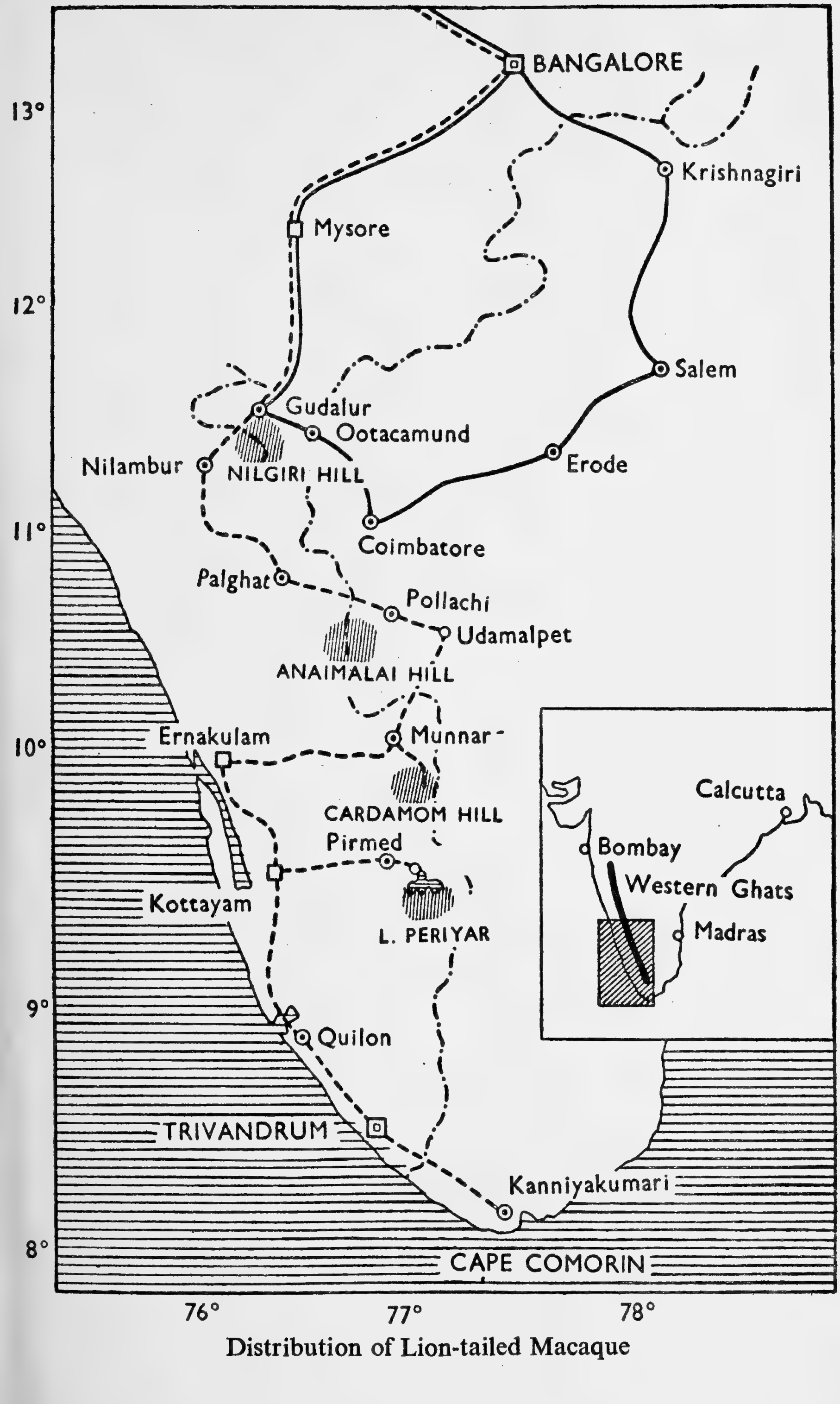


Distribution of Lion-tailed Macaque

# *Hedychium longipedunculatum*, a new species of Zingiberaceae from Subansiri District, North East Frontier Agency

BY

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*Botanical Survey of India, Eastern Circle, Shillong*

(*With a plate*)

During a botanical exploration of Subansiri District, in May 1966, a frequently occurring epiphytic *Hedychium* in flower, attracted attention. Apart from herbarium specimens, live plants of this were also gathered and grown in the crotch of a *Cinnamomum* tree, along with other epiphytes like *Vaccinium* and some orchids of the same area, in the 'woodlands' experimental garden, Shillong. In this almost natural habitat, the *Hedychium* flourished and bloomed again in May, 1967. A detailed study of the live and dry specimens strongly suggested it being a new species. A follow-up study at the Central National Herbarium, Calcutta, confirmed this, and incidentally revealed two earlier undescribed collections of identical material from Naga Hills also. Accordingly, based upon all the material, the new species is described here.

**Hedychium longipedunculatum** sp. nov.

Affine *H. densifloro* Wall., a quo differt foliis ellipticis, pedunculo longissimo, spicis floralibus multo brevioribus, bracteis corollae tubo brevioribus, staminodiis spathulatis, ovario dense villoso, antherarum cellulis ad basin divergentibus.

Epiphyticum. Rhizoma repens, pallide, griseo-viride extus, pallide viridescenti-luteum intus, paulum aromaticum. Radices tuberosae. Caules annui, 25-40 cm. alti, glabri. Folia alterna, 4-6 numero, inferiora sessilia, superiora petiolata ; petiolis 3-16 mm. longis, vaginatis; ligula 0·5-2 cm. longa, membranacea, ad apicem biloba, glabra ; lamina 4-23 × 1·5-10 cm., elliptica vel oblongo-elliptica, acuta ad basin, ad apicem abrupte spiraliter caudato-acuminata ; acumine ad 2·5 cm. longa ;

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[1] Present address : Central Botanical Laboratory, Botanical Survey of India, Calcutta.

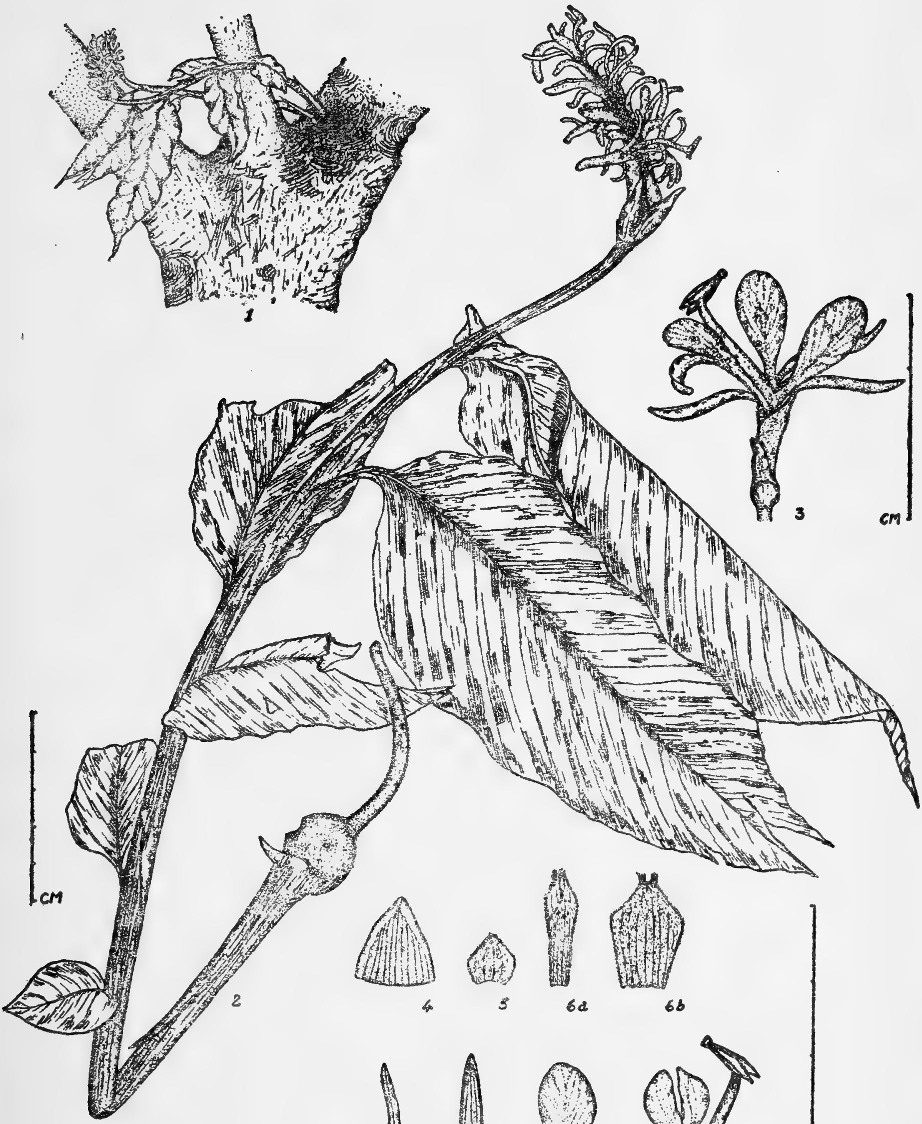
marginibus integris, hyalinis ; facie utraque glabra, viridescente supra, pallide purpurea infra ; nervo medio distincto, haud alte canaliculato supra, eminenti infra ; nervi laterales plures, arcuati sursum. Pedunculi 5-14 cm. longi, paulum curvati, glabri ; rachis pilosa ; spicula 4-6 cm. longa, densiflora ; bracteae uniflorae, 11 mm. longae, 7 mm. latae ad basin, triangulares, convolutae, 9-11-nerviae, glabrae, 2 mm. calyce breviores, obtusae ad apicem ; bracteolae 6×4 mm., ovatae, acutae, membranaceae, leniter 3-nerviae, hirsutae extus, glabrae intus. Flores 3 cm. longi, cremei, fragrantes. Calyx tubulosus, partim bractea inclusus, 11 mm. longus, oblique ad os divisus, 7-9-nervius, dense villosus extus, glaber intus, membranaceus, duplici fasciculo capillorum longorum ad apicem. Corollae tubus calyci aequilongus, glaber extus, villosus intus ; laciniae 3, 16×3 mm., lineari-lanceolatae, 3-nerviae, pallide rubro-brunneae maculatae, (emphatice cum siccae), convolutae, acutae ad apicem. Staminodia bina, 17 mm. longa, 7 mm. lata, petaloidea, spathulata, cremea, paulum crassa, obscure nervosa. Labium alte bilobum distincte unguiculatum ; ungue 5×2 mm. ; lamina fere elliptica, divisa fere usque ad basin ; lobis 10×3 mm., oblongis, obtusis. Stamen unicum ; filamentum 15 mm. longum, 2 mm. crassum, labio incumbens ; anthera 7 mm. longa, bicellularis ; cellulae ad basin divergentes ; connectivum 2·5 mm. latum. Ovarium 3 mm. diam., subglobosum, obscure triangulare, dense villosum, triloculare ; placentae axiles ; stylus filiformis, 3·3 cm. longus ; stigma paxilliforme ad antherae apicem, 1 mm. latum, truncatum, ciliatum. Capsula 1·5 cm. diam., subglobosum, triangulare, pilosum ; valvulae ternae, patentes, carnosae, aurantiacae intus ; semina 3×1 mm. ellipsoidea, levia ; arillus carnosus, nitenter ruber.

Holotypus, *A. R. K. Sastry* 45509 A, lectus ad Amjee, ad 1220 m. alt. in Subansiri districtu 22-5-1966, positus in Herbario Nationali Centrali (CAL) ; isotypi, *A. R. K. Sastry* 45509 B-H in herbario Kanjilal ad Shillong (ASSAM).

### **Hedychium longipedunculatum** sp. nov.

Allied to *H. densiflorum* Wall., but differs in its elliptic leaves ; very long peduncle, but much shorter flowering spikes ; bracts shorter than corolla tube ; spathulate staminodes ; densely villous ovary and anther cells divergent at base.

Epiphytic. *Rhizome* creeping, pale greyish-green outside, light greenish-yellow inside, slightly aromatic. *Roots* tuberous. *Stem* annual, 25 - 40 cm. tall, glabrous. *Leaves* alternate, 4 - 6, lower sessile upper petioled ; petiole 3-16 mm. long, sheathed ; ligule 0·5-2 cm. long, membranous, 2-lobed at apex, glabrous ; lamina 4 -23×1·5-10 cm. elliptic or oblong-elliptic, base acute, apex abruptly, spirally caudate-




*Hedychium longipedunculatum* Sastry et Verma

1. Habit. 2. Plant. 3. Flower. 4. Bract. 5. Bracteole. *6a*. Calyx. *6b*. Calyx split open. 7. Lateral corolla segment. 8. Dorsal corolla segment. 9. Staminode. 10. Lip and Stamen. (*A.R.K. Sastry* 45509 *G*.)

acuminate ; acumen up to 2·5 cm. long ; margins entire, hyaline ; surfaces glabrous, greenish above, light pinkish-purple beneath ; midrib distinct, shallowly grooved above, raised beneath ; lateral nerves many, arched upwards. *Peduncle* 5-14 cm. long, slightly curved, glabrous ; rachis hairy ; spike 4-6 cm. long, dense flowered ; bracts 1-flowered, 11 mm. long, 7 mm. broad at base, triangular, convolute, 9-11-nerved, glabrous, 2 mm. shorter than calyx, apex obtuse ; bracteoles 6 × 4 mm., ovate, acute, membraneous, faintly 3-nerved, hirsute without, glabrous within. *Flowers* 3 cm. long, creamy yellow, fragrant. *Calyx* tubular, partly enclosed by the bract, 11 mm. long, obliquely split at mouth, 7-9-nerved, densely villous without, glabrous within, membranous, with 2 tufts of long hairs at apex. *Corolla tube* as long as calyx, glabrous without, villous within ; segments 3, 16 × 3 mm. linear-lanceolate, 3-nerved, light red brown dotted (distinct when dry), convolute, apex acute. *Staminodes* 2, 17 mm. long, 7 mm. broad, petaloid, spathulate, creamy, slightly thick, obscurely veined. *Lip* deeply 2-lobed, distinctly clawed ; claw 5 × 2 mm. ; lamina nearly elliptic, divided near to the base ; lobes 10 × 3 mm., oblong, obtuse. *Stamen* single, filament 15 mm. long, 2 mm. thick, resting on the lip ; anther 7 mm. long, 2-celled ; anther cells divergent at base ; connective 2·5 mm. broad. *Ovary* 3 mm. in diameter, sub-globose, obscurely 3-angled, densely villous, 3-celled ; placentation axile ; style filiform, 3·3 cm. long ; stigma peg-like at anther tip, 1 mm. broad, truncate, ciliate. *Capsule* 1·5 cm. in diameter, sub-globose, 3-angled, hairy without ; valves 3, spreading, fleshy, orange coloured within ; seeds 3 × 1 mm. ellipsoid, smooth ; aril fleshy, bright red.

N.E.F.A. : SUBANSIRI DISTRICT : Amjee, *c* 1220 m., 22-5-1966, *A. R. K. Sastry* 45509 A (Holotype—CAL) ; *A. R. K. Sastry* 45509 B-H, H in fr. (Isotypes—ASSAM) ; Begi—Amjee, 12-5-1966, *A. R. K. Sastry* 45222 in fl. ; Hapoli vicinity, 28-5-1966, *A. R. K. Sastry* 45584 in fl. (Paratypes—ASSAM).

NAGA HILLS : July 1844, *Anon.*, *s.n.*, (CAL, Accn. No. 466858) in fl. ; Konoma Hill, (7500′, *c* 2500 m.), 19-5-1895, *G. Watt* 11609 in fl. (Paratypes—CAL).

## ACKNOWLEDGEMENTS

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# A Report on Wild Life Surveys in South and West India

## November-December 1966

BY

J. JUAN SPILLETT

## Wild Life Sanctuaries in Mysore State

(*With two plates and three maps*)

(*Continued from Vol.* **65** (1) : 46)



TABLES AND MAPS

## I. INTRODUCTION

The princely state of Mysore, which became a part of the Indian Union after Independence in 1947, was world renowned for its abundance of wild animals. Primarily due to the numerous royal shoots for tiger and other big game, there was a state-wide interest in wild life. This led to the enactment of the Mysore Game and Fish Preservation Act of 1901, which helped to prevent the indiscriminate destruction of the State's wild life, and resulted in the organization of perhaps the first game or wild life staff in India. The Maharaja of Mysore, a devoted wild life enthusiast, was the first chairman of the Central Indian Board for Wild Life, which was organized in 1952. A Mysore State Wild Life Board to advise the State Government on matters pertaining to wild life preservation also was established in 1952. The Chief Minister is the chairman of this committee which meets annually, whereas the Central Board only meets every other year. Mysore became an integrated State in 1956 and the Mysore Wild Animals and Wild Birds' Act was enacted in 1963 to establish a uniform code for wild life for the integrated State.

The State's first wild life sanctuary was established in 1931 and consisted of a 35-square-mile area near Chamarajanagar in the District of Mysore. It was later realized that this sanctuary was too small to constitute a complete ecological unit. Therefore, the area was reverted back to the status of a wild life preserve and in 1941 a much larger area to the west was set apart as the Venu Gopal Wild Life Park, which includes the well-known Bandipur Sanctuary.

The large islands of Devaraja, Ranganathittu and Gandehosahalli, as well as a number of smaller islands in the Cauvery River, were constituted as Bird Sanctuaries in 1940. The Jager Valley and Baba Buddin Wild Life Sanctuary in Chikmagalur District was established in 1941.

[1] This survey was officially sponsored by the World Wildlife Fund, Morges, Switzerland. The project was also assisted by The Johns Hopkins University and its Center for Medical Research and Training, Calcutta and Baltimore, Maryland (U.S.A.). Mr. E. P. Gee, member of the Indian Board for Wild Life, made the necessary arrangements with the Government of India and the Forest Department of Mysore, both of which extended the fullest co-operation.

The Dandeli Wild Life Sanctuary in North Kanara District, which was originally in the State of Bombay, was established in 1945. The Nagerhole Wild Life Sanctuary in Coorg District, which was originally the Class ' C ' State of Coorg, was established in 1955. Both the Dandeli and Nagerhole wild life sanctuaries came under the jurisdiction of Mysore when it became an integrated State in 1956 (Map 1). Mysore has the potential for presenting perhaps the best system of wild life sanctuaries and parks of any state in the Indian Union.

## II. General account of the Survey

Two delegates from the Mysore Forest Department met me upon my arrival in Bangalore the evening of November 22, 1966. Because it was late and I planned to take the early morning train to the city of Mysore, we only briefly discussed the wild life situation in Mysore State. Mr. Monnappa, Wild Life Officer of Mysore, and members of his staff met me upon my arrival in the station of Mysore on the morning of the 23rd. The afternoon was spent visiting the Ranganathittu Bird Sanctuary and other points of interest in the vicinity of the city of Mysore.

We travelled to the Nagerhole Wild Life Sanctuary, approximately 50 miles north-west of Mysore, the morning of November 24. The afternoon was spent touring some of the sanctuary's interior roads by jeep. The entire day of the 25th was spent on elephant back west of the Nagerhole Forest Rest House. The following day we were accompanied by Mr. Syed Hussain (Coorg Divisional Forest Officer) to Thithimathi and also visited the Hebballa Elephant Camp, which is located on the banks of the Lakshmantirtha River in the heart of the Nagerhole Sanctuary. We then returned to Mysore via Hunsur.

Mr. Monnappa and I travelled to Chamarajanagar on November 27, where we met Mr. Alva (Chamarajanagar Divisional Forest Officer). Mr. Alva accompanied us on a tour of the Biligirirangan Hills and the Chamarajanagar Wild Life Preserve, which are located south-west of the town of Chamarajanagar. It has been proposed that this area be constituted as a wild life sanctuary, a distinction which it well deserves. The natural beauty and the wild life of this area are worthy of note and could readily establish it as an outstanding tourist attraction. In addition, the basic amenities for visitors, such as forest rest houses and a good network of roads, are present already and the establishment of the area as a wild life sanctuary and major tourist attraction would involve relatively very little capital investment. We returned to Chamarajanagar that night and Mr. Monnappa and I then continued on to the Venu Gopal Wild Life Park, arriving at Bandipur early the morning of the 28th.

November 28 was spent inspecting the Venuvihar Forest Rest House, located on the summit of a 4,769-foot high hill along the northern boun-

dary of the Venu Gopal Wild Life Park and adjacent to the Venu Gopal Temple. We also inspected a number of the tiger blocks north of the Park and toured some of the roads inside the Park and the Bandipur Sanctuary.

We toured the Park roads east of the Bandipur Forest Rest House the morning of the 29th and then spent the afternoon on elephant back to the west. Mr. Alva arrived from Chamarajanagar that evening and we discussed at length the problems confronting wild life in this area and some of the possible means by which the true value of wild life in both Mysore State and in India might be realized.

Mr. Monnappa accompanied me to the Mudumalai Wild Life Sanctuary in Madras State on the morning of November 30th. Mudumalai adjoins both the Venu Gopal Wild Life Park in Mysore State and an outstanding wild life area in Kerala State, which also has been proposed as a wild life sanctuary. With the establishment of the adjoining wild life sanctuary in Kerala, the Venu Gopal-Mudumalai-Kerala areas would constitute one of the most complete ecological units in India dedicated to the preservation of wild life. This completed my brief tour of some of the wild life areas in Mysore State.

## III. The Ranganathittu Bird Sanctuary

### Introduction

The Ranganathittu Bird Sanctuary was established in 1940 and is the oldest existing wild life sanctuary in Mysore State. It received its name from the 66-acre Ranganathittu Island in the Cauvery River near the village of Palahalli, which is 12 miles north of the city of Mysore and two miles upstream from the railway station at Srirangapatna. Besides a number of lesser islands in the vicinity of Ranganathittu, also included in the sanctuary are the islands of Gandehosahalli and Devaraja. The two islands of Gandehosahalli are located about 8 miles downstream from Srirangapatna and include a total area of 86·23 acres. The 15-acre Devaraja Island is 6 miles upstream from Ranganathittu and about three-fourths of a mile downstream from the Krishnarajasagar Dam. Devaraja is a denuded island, which is submerged frequently by waters released from the Krishnarajasagar Dam. The major islands, including Ranganathittu, serve primarily as resting sites for birds, whereas the vast majority of the sanctuary's water birds nest on the lesser islands along the southern side of Ranganathittu. Therefore, although the sanctuary includes a total area of over 167·39 acres, nesting water birds may be observed only on a few small islands adjacent to Ranganathittu.

## Visitor Facilities

A metalled road, which is about three-fourths of a mile long, leads from the Paschimavahini-Krishnarajasagar Highway to the south bank of the Cauvery River. The turn-off is well-marked with an impressive sign, which both advertises and depicts the sanctuary's bird life. A ' pergola ' or observation platform is located at the end of the road on a point overlooking the river and a footpath extends upstream along the south bank. From this well-camouflaged path, visitors may readily observe the nesting water birds and their young on the small islands about 75 feet off-shore. There is also an observation tower on the south side of Ranganathittu Island, but the birds can be observed better from the path on the opposite bank of the river.

A Forest Department Forester and a Watcher are stationed at Palahalli to guide or assist visitors to the sanctuary. A double boat (Plate I) and a coracle (a round, basket-like boat) are also provided. However, visitors are not permitted to approach the nesting birds closely. When disturbed, the parent birds fly away and the young birds are often attacked by crows and some fall out of their nests and either drown in the river or eventually starve.

There are no rest house facilities at the Ranganathittu Bird Sanctuary, but there are a number of good hotels in the city of Mysore. A first class hotel also is located below the Krishnarajasagar Dam, which is the site of the beautiful Brindavan Gardens. Coloured lights are played upon the numerous fountains in the garden on Wednesday, Saturday and Sunday evenings. As a result, the gardens have become a notable tourist attraction.

The nearest airport to Ranganathittu is at Bangalore, 86 miles north-east of the city of Mysore. The two cities are connected by both frequent train and bus services. The journey takes about four hours by meter-gauge train, but first class express buses take less than three hours. The Government Tourist Department also conducts bus tours of Mysore and its environment. Although Ranganathittu presently is not included in their itinerary, it is hoped that in the future it will be. Most of the tours pass near the sanctuary and at least a brief visit could be arranged very easily.

Major attractions within the vicinity of Ranganathittu include the Brindavan Gardens, which have been mentioned previously, the one and one-fourth mile long Krishnarajasagar Dam, which is constructed entirely of cut stone, and the 50-square-mile Krishnarajasagar Lake. Srirangapatna is an island in the Cauvery River about two and one-half miles below Ranganathittu. It served as the capital of the Mysore Rajas from 1610 until 1799 when Tippu Sultan died in the final battle with the British. Within the fort on Srirangapatna is a Hindu temple

(Sri Ranganath), which is over 500 years old, and a Muslim mosque (Juma Masjid). By climbing the minarets of the mosque one is able to view an impressive panorama of the fort and the surrounding countryside. Other attractions include Tippu Sultan's summer palace which is located outside the fort, and the mausoleum (Gumbaz) where he is buried, which is situated near the lower end of the island where the two forks of the Cauvery River rejoin.

**Fauna**

Water bird nesting activity begins in the Ranganathittu Bird Sanctuary by late May and is followed closely by egg laying. Hatching, which coincides with the main monsoon season, generally begins by mid-June. There are two monsoons in this area ; the south-west monsoon, which begins in June and lasts until September, and the north-east monsoon, which lasts from October until December. The young birds are full-fledged by the end of November and most of the birds then leave the sanctuary. Although a few birds are present throughout the year, the best time to observe the sanctuary's birds is between June and October.

Most common among the nesting water birds are : openbill storks, white ibis, little and cattle egrets, darters or snake-birds, paddy birds or pond herons and spoonbills. Night herons, river terns, lapwings, curlews, sandpipers, and other water birds, as well as several species of migratory waterfowl also are present. Numerous species of lesser birds, particularly the passerines, may be observed in the trees and bushes along the banks of the Cauvery. Nearby Srirangapatna is considered a Blue Rock Pigeon Preserve. There are numerous pigeon nests in the old ruins of the fort and particularly on the minarets of the mosque. This species is considered by many as the forerunner of our domestic pigeon.

A large colony of giant fruit bats or ' flying foxes ' (*Pteropus giganteus*) also roosts in the large trees of a small island opposite the sanctuary's pergola. Although their numbers vary considerably during the year, I counted over 500 bats during our visit on November 23rd. These huge bats have an average wingspread of approximately three feet. They present an impressive spectacle, particularly to foreign visitors, when in the evening they drop from the branches and silently wing their way into the surrounding countryside to forage for food during the night.

## Discussion

The primary reason the water birds utilize the small islands in the Cauvery River for nesting sites undoubtedly is the protection they afford from man and predatory animals. Another factor which attracts them to this particular area is the abundance of food in the surrounding

agricultural lands. The sanctuary's birds feed extensively upon insects and aquatic organisms, many of which are harmful to crops. Their droppings or guano also help to maintain the fertility of the surrounding fields. Thus, the presence of these birds results in incalculable benefits to the economy of this area. Apart from aesthetic values, an additional benefit and potential source of revenue which has not yet begun to be realized, is the development of Ranganathittu as a major tourist attraction.

Ranganathittu Island has a fairly luxuriant tree growth along its margins. However, most of the island is severely overgrazed by domestic livestock from near-by villages. As a result, it is for the most part a barren area with only sparse scrubby vegetation. Herders, who accompany the livestock on the larger islands of the sanctuary, also disturb whatever birds that attempt to colonize them and have contributed to the almost complete absence of wild life in these areas.

Areas set aside and constituted as wild life sanctuaries should be maintained in as natural a condition as possible. It is to be hoped that the Government of Mysore will shortly take steps to ensure that this is done at the Ranganathittu Bird Sanctuary. Besides benefiting the people of the State as a whole, the surrounding villagers eventually would receive much greater benefits from the sanctuary than they presently receive from the grazing of some of their livestock within its confines. Without the disturbance by villagers and their livestock I believe that many of the water birds would eventually utilize some of the larger islands for nesting sites. Primarily this would be desirable for two reasons: (1) Greater numbers of water birds could reside in the sanctuary, which would benefit the surrounding agricultural lands and make the sanctuary an even greater attraction. (2) The nesting colony would not be as subject to the havocs of flood waters caused by heavy rains or the opening of the gates at the Krishnarajasagar Dam. Further, other birds such as peafowl, jungle fowl and partridges, which the Forest Department has attempted to introduce upon these islands with little success, would probably take hold and thrive if they were left undisturbed and sufficient natural cover and food were available.

A major problem confronting the nesting water birds of Ranganathittu is flooding. When there are exceptionally heavy monsoon rains the gates on the Krishnarajasagar Dam are opened, often with devastating effects upon the nesting colonies. This practice should be discouraged and an effort made to release excess waters from the dam as slowly as possible. Devaraja Island, about three-fourths of a mile below the dam, is almost completely barren of vegetation because of this practice. Also, on several occasions the entire season's production of young water birds has been destroyed by the sudden rush of waters released from the dam. It is realized that the protection of the dam is of primary importance, but

Ranganathittu's birds also should receive consideration and often with a little foresight their destruction could be lessened, if not averted completely.

The manner in which the Forest Department has established and maintained Ranganathittu is highly commendable. This is particularly true when it is realized that this is done on a very limited budget and that the Department presently realizes no revenue what so ever from this sanctuary. I was especially impressed by the path along the south bank of the river, which is well maintained and constructed in such a way that visitors may readily observe the nesting colony of birds without disturbing them. However, for the most part, the surrounding fields encroach upon the sanctuary to the extent that there is room for little more than a path along the bank of the river. Additional land in this area should be constituted as a part of the sanctuary. If nothing else, at least a few additional feet along the path should be acquired to help give it a park-like appearance. Space also is needed in the vicinity of the pergola to provide parking, particularly for buses. A small picnic area likewise would be desirable. Further, it is suggested that the Forest Department charge a very nominal fee to those visiting the sanctuary. Besides helping to provide funds for the maintenance of the sanctuary, this would perhaps impress upon visitors the value of wild life sanctuaries and the fact that many people would be willing to pay much to have the opportunity to see a spectacle such as the birds of Ranganathittu.

## IV. THE NAGERHOLE WILD LIFE SANCTUARY

### Introduction

The 111-square-mile Nagerhole Wild Life Sanctuary, which was originally in the State of Coorg, was established on July 19, 1955 by notification from the Chief Commissioner of Coorg. Included in the sanctuary are parts of three reserved forests : Arkeri, Hatgat and Nalkeri. The Thithimathi-Anechowkur road forms the northern boundary, demarcated forest lines the eastern and western boundaries and the Kerala State line the southern boundary (Map 2).

The Hunsur Divisional Forest Office and the Divisional Forest Officer in charge of the Nagerhole Sanctuary are located at Hunsur, 28 miles west of the city of Mysore. Hunsur also serves as a timber depot for forest operations in this area. Regretfully, the sanctuary is devoted primarily to the production of forest produce. Approximately 20,000 acres of the sanctuary presently are devoted to teak (*Tectona grandis*) plantations and about 2,000 acres of teak plantation are included in the sanctuary's ' sanctum sanctorum.' Also, 90 acres have been planted

with *Eucalyptus* and the parasitic Sandalwood (*Santalum album*) has been mixed with teak on 136 acres. Soil conservation schemes, which primarily involve the planting of trees on barren areas, were initiated in 1963 on an additional 1,080 acres in the sanctuary.

There are 12 villages in the Nagerhole Sanctuary. Nine of these are inhabited by tribal people resettled here by the Social Welfare Department and one of these villages is located in the sanctuary's 5-square-mile sanctum sanctorum. The total population of these villages exceed 4,000 people and their cultivated lands inside the sanctuary approximate 500 acres.

Livestock grazing supposedly is excluded from the sanctuary's sanctum sanctorum. However, with this exception, the entire sanctuary is open to the free and unrestricted grazing of domestic livestock. It is estimated conservatively that between 1,500 and 2,000 head of cattle and buffalo graze in the sanctuary on a year round basis. Other animals are seasonally grazed in the sanctuary or graze while passing through the area.

The western side of the sanctuary is bordered by extensive coffee plantations. Additional pressures are exerted upon the sanctuary, particularly from this side, for livestock grazing, firewood and other forest produce by those living along its borders. Although there are some beautiful areas of natural forest in the interior, travelling through the sanctuary from Murkal to Kutta or along the northern boundary, one gains the impression that the Nagerhole Wild Life Sanctuary is little more than an extensive teak plantation intermingled with forest villages.

## Visitor Facilities

Forest rest houses are located conveniently in the Nagerhole Wild Life Sanctuary at Murkal, Nagerhole and Thithimathi. The Murkal Forest Rest House is located along the eastern border and provides 4 suites (2 double and 2 single) with all facilities, i.e., bedding, cook, etc. Murkal is 18 miles south-west of Hunsur via a black-topped road and is served by daily bus service. Also located at Murkal are a Forest Department sawmill, seasoning kiln, carpenter training school and a carpentry section where furniture is manufactured.

The Nagerhole Forest Rest House is 12 miles south-west of Murkal and provides 2 double suites with all facilities. Six of the 12 miles of road between Murkal and Nagerhole are black-topped and the other 6 are metalled. Nagerhole, which means ' cobra stream ' in Kanarese, may be reached by bus from Mercara via Gonegopal and Kutta, a total distance of 58 miles. There are some beautiful sylvan areas to the south and east of the Nagerhole Forest Rest House. These may be visited on riding

elephants, which are provided for visitors at Nagerhole by the Forest Department.

A small rest house with one suite, but no services, is available at Kalhalla, mid-way between Murkal and Nagerhole. The Thithimathi Forest Rest House with 2 double suites and all facilities is located along the northern boundary of the sanctuary. It is 22 miles west of Hunsur and 30 miles from Nagerhole via Kutta and Gonegopal.

There is an almost continuous forest belt along the eastern slopes of the Western Ghats in Mysore. However, the average width of this belt is only about 5 miles. In addition to the aforementioned forest rest houses in the Nagerhole Sanctuary, small forest lodges are located at approximately 8-mile intervals along the entire length of this forest belt. These are linked with fair-weather roads and may be used with prior permission from the Divisional Forest Officer in the area concerned. However, these lodges are for the most part unfurnished and only a few have modern facilities.

A site of particular interest for visitors to the Nagerhole Sanctuary is the Hebballa Elephant Camp located in the heart of the sanctuary along the north bank of the Lakshmanathirtha River. Although a 16-mile road runs north from Nagerhole to the Lakshmanathirtha, the camp is on the opposite side and the river can be forded by jeep only during the dry season. Therefore, the camp is generally reached by a metalled road from Thithimathi, a distance of 8 miles. The best time to visit Hebballa is before 08.00 in the morning when the elephants are taken into the forests to work or to graze or after 05.00 in the afternoon when they are brought back to the camp for the night.

Elephant kheddas (the driving and capturing of wild elephants in stockades) were formerly conducted at roughly 5-year intervals at Kakanakote. The kheddas are located along the north bank of the Kabini River, about 15 miles south of the Nagerhole Forest Rest House. After the khedda some of the captured elephants were then brought to Hebballa for training. However, due to the construction of a dam on the Kabini the backwaters of which will shortly inundate the khedda area, the final khedda operations were scheduled for the early part of 1967. Elephants for the training camp will now be caught by pit method in other areas between November and April on alternate years. There were 55 domestic elephants in the Nagerhole Sanctuary during my visit. Most were being used for forest operations, although a few were receiving their final stages of training at Hebballa. Thirty-five elephants were stationed at Hebballa, 11 at Nagerhole and the remaining 9 elsewhere in the sanctuary. There were no elephants in the early stages of training. Therefore, the large ' kraals ' or pens at Hebballa were empty. However, it was very interesting to observe the elephants working in the forests bathing in the river and so forth.

I was also informed that the mahseer (*Tor tor*) is ' common ' in particular stretches of the Cauvery, Kabini and Lakshmanathirtha rivers, as well as the Tunga, Bhadra, and Sharavati. This game fish is noted for its fighting ability and for the remarkable size which it often attains. A 121 pound mahseer is the record for this species in Mysore. Van Ingen and Van Ingen taxidermists in the city of Mysore also have an impressive collection of mahseer teeth, as well as other wild life specimens which are well worth making arrangements to see.

## Habitat

### Flora

The Western Ghats are a narrow chain of hills running north and south along the western side of Mysore State, extending from Madras and Kerala in the south to Maharashtra in the north. They attain a maximum height of 8,000 feet in the Nilgiri Hills, but rarely exceed 5,000 feet in the western part of Mysore. Most of the forest areas and wild life sanctuaries of Mysore are located along their eastern slopes. Although the forests of this region vary somewhat with altitude and other factors, the natural moist deciduous forests remaining in the Nagerhole Wild Life Sanctuary are more or less typical for much of the Western Ghat region of the State (Table 1). Rainfall for most of this region varies between 60 and 70 inches per annum and occurs primarily between June and September, during the south-west monsoon.

Economic advisors claim that a modern nation must perpetually maintain an average of at least 1·0 acre of forest per person in order to maintain a basically sound national economy. The total area of Mysore State is 74,122 square miles, of which 18·4% or 13,575 square miles are classified as forest lands. However, many areas classified as forests are in actuality little more than barren wastes. Presently there is less than 0·54 acre of so-called forest lands per capita in India as a whole and only 0·46 acre per capita in the State of Mysore ! Nevertheless during recent years more and more forest lands, which are for the most part submarginal for agricultural use, have been cleared for crops. As these lands are eventually depleted they become deserts or barren wastes which are of little or no economic value. In addition, accelerated erosion upon these lands often results in the devastation of rich agricultural lands below and reforestation of these once prime forest areas becomes a slow and costly process. Therefore, the present trend should be reversed. India drastically needs an extensive and well-planned programme of reforestation and the emphasis should be placed on intensive rather than extensive agricultural land use.

TABLE 1. SPECIES COMPOSITION OF THE NATURAL MOIST DECIDUOUS FORESTS IN THE NAGERHOLE WILD LIFE SANCTUARY IN MYSORE STATE

| Local or Common Name | Scientific Name | Percent of Stand or Remarks |
|---|---|---|
| *TREES :* | | |
| Mathi | *Terminalia tomentosa* | 40% |
| Teak | *Tectora grandis* | 30 |
| Rosewood | *Pterocarpus marsupium* | 5 |
| Honne | *Lagerstroemia lanceolata* | 5 |
| Nandi | *Terminalia tomentosa* | 5 |
| Uluve | *Terminalia paniculata* | 5 |
| Thadasalu | *Grewia tiliaefolia* | 2 |
| Arasinatega | *Adina cordifolia* | 1 |
| Noga | *Cedrela toona* | 1 |
| Nelagodda | *Garuga pinnata* | 0·5 |
| *SHRUBS :* | | |
| Seeme Seege | *Lantana camara* | common |
| | *Desmodium pulchellum* | common in moist areas |
| Kowri | *Helicteres isora* | present |
| Mandalamari | *Cipadessa fruticosa* | present |
| *CLIMBERS :* | | |
| Strangler Fig | *Ficus* sp. | fairly common |
| Muthaga hambu | *Butea superba* | present |
| Kadavave hambu | *Spatholobus roxburghii* | present |
| Seege Kaye | *Acacia concinna* | present |

Note :

1. All of the bamboo (*Bambusa arundinacea*) in the sanctuary flowered and died in 1965. Therefore, it presently does not enter into the sanctuary's floral composition.
2. Species listed as comprising the natural shrubs have been replaced to a great extent since 1960 by *Eupatorium glandulosum*.
3. Grasses and herbs were not identified.

Two methods of forest operation are used at present in the forests of the Nagerhole Sanctuary : (1) Selective cutting, which involves primarily the harvesting of mature trees in natural forests. (2) Clear felling, where entire forest blocks are cleared and then usually burned prior to plantation planting. The planting of teak is becoming increasingly common, although the planting of fast growing species such as *Eucalyptus* also is being advocated. The fast growing or soft wood species are in demand primarily by the paper pulp and rayon mills. Dead bamboo, which is being collected from the sanctuary, presently is being supplied to Kerala.

Big bamboo (*Bambusa arundinacea*) generally constitutes a conspicuous part of the sanctuary's floral composition. However, practically all of the bamboo in this area flowered, set seed and then died in 1965. It is claimed that this occurs every 40 to 50 years, after which is takes a few years for the seeds to germinate and establish the species once more. As a result of the 1965 bamboo die-off, there is at present a scarcity of fodder for elephants and to some extent for gaur in the sanctuary.

Theoretically pure stands of the same age and species of trees are desirable for efficient forest operations. However, in practice, plantations of pure teak present a number of major problems. Perhaps most important of these are : (1) the deterioration of soil and the lowering of site quality, and (2) the production of a lower quality of timber. Teak seedlings are intolerant of weeds and other plant growth. Thus, they are cultivated for at least the first three years after planting. After the canopy becomes established, there is little undergrowth and little accumulation of humus. Therefore, erosion often is very much in evidence. Also, due to increased competition from weeds and increased vulnerability to insects and other parasites generally the growth of pure stands of teak is retarded and the quality of the timber decreases.

An introduced plant (*Lantana camara*) formerly was an undesirable component of many teak plantation areas. However, since 1956 in many parts of Mysore it has been replaced to a great extent by the introduction of the even less desirable *Eupatorium glandulosum*. This shrub-like weed has woody stems, grows to a height of over 8 feet and appears to be unpalatable to almost all forms of endemic wild life. Its winged seeds, dispersed by wind, germinate and spread like wild-fire in disturbed open areas, such as along roadsides, plantations, and so forth. It was first noticed in the Nagerhole Sanctuary in 1956, but did not become a major problem until about 1960. Because of the presence of *Eupatorium*, the growth of teak has been retarded greatly in many plantation areas and in some cases a good number of the teak seedlings have died. The Forest Department presently is waging a costly and what appears to be futile battle in attempting to control this weed.

The Forest Department presently weeds its teak plantations by hand three times during the first year, twice in the second, and once during the third year and then hopes that the stand is established well enough to hold its own thereafter. Tending, thinning and the cutting of climbers, however, is needed at various intervals before the tree crop may be harvested at an age of between 80 and 100 years. The point is this, such a crop may be devastated at any time during its 80 to 100 year rotation period and practically the entire investment may be lost. A natural or mixed crop of trees generally lessens this vulnerability, although to some extent it may complicate the forest operations.

The Forest Department should note that *Eupatorium* is almost completely absent in the natural forests of the sanctuary and a parasitic growth (*Loranthus sp.*) of teak is much more in evidence in plantation areas than in natural forests. Because of two moths, *Hyblaea puera* a defoliator and *Hapalia machaeralis* a leaf skeletonizer, the trees in many of the teak plantations of Nagerhole were almost completely defoliated at the time of my visit in November. Little growth can be expected from trees in such a state even under ideal climatical conditions.

Epidemic outbreaks of such pests also are more prevalent and more serious in pure rather than mixed stands.

**Fauna**

The mammalian fauna of Nagerhole is very similar to that of the Venu Gopal Wild Life Park (see Table 3). In fact, elephant and perhaps gaur appear to have seasonal movements or migrations between the two areas. Just what effect the construction of the dam on the Kabini River, the impounded waters of which will cross their migratory route, remains to be seen.

Mammals observed during my visit to the Nagerhole Wild Life Sanctuary include the following : chital (33), gaur (14), Malabar squirrel (6), numerous common langur and a small bright coloured squirrel, which may have been a flying squirrel. All but one of the male chital observed had shed their antlers recently or had antlers in velvet. Chital often keep company with the common langur, which drop leaves and fruit from the trees upon which the chital feed. Seven of the gaur were adult males. One was a magnificent beast with an estimated horn spread of about 38 inches, even though the tips of both horns were broken. A solitary bull, which we met on the trail while returning to camp one evening, challenged our elephant and rather than calling the old fellow's 'bluff' we finally made a detour and let him rule the trail. The bird life of Nagerhole also is similar to that of Venu Gopal (see Table 4). One exception is that peafowls appear to be very rare in Nagerhole, while relatively common in Venu Gopal.

## Discussion

A 'sanctum sanctorum' may be defined as an area maintained in as natural a state as possible—free from the encroachment of man. Originally a 5-square-mile 'sanctum sanctorum' was established in the Nagerhole Wild Life Sanctuary. This area surrounds the Nagerhole Forest Rest House, east of the Murkal-Nagerhole road. However, this so-called 'sanctum sanctorum' has been repeatedly desecrated. About 2,000 acres or over 3/5's of the area is devoted to teak plantations and a village has been located here. The entire area is disturbed almost continually by forest operations. Presently it is proposed that the 'sanctum sanctorum' be enlarged to include a 35-square-mile area south and east of the road between Murkal and Nagerhole, and although there are some teak plantations along the road, after the mature trees have been removed the area be kept inviolate for 30-35 years.

I realize that the revenue from the sanctuary's forest produce is considerable. Nevertheless I would like to suggest that a core area of

at least 5 square miles be perpetually maintained in its natural state and the plantations be excluded from the surrounding forests of this core area for at least 35 square miles, although the mature trees or the forest produce of this surrounding area may be systematically exploited.

Because of the forest villages and the numerous labourers who enter from the coffee plantations to the west, poaching is a major problem in the Nagerhole Wild Life Sanctuary. Jeeps and lorries, especially those that ply the roads at night, contribute to the problem of wild life conservation. The stealing of forest produce is a fairly common practice. It appears that the most logical steps to curtail such violations would be the following : (1) Resettle elsewhere the tribal villagers residing in the sanctuary. Or, if this is not possible, at least consolidate the villages so that illegal activities within the sanctuary may be minimized. The Social Welfare Department is advocating that crop protection guns be issued to the tribal colonies which it has established in the sanctuary. If this is permitted, Nagerhole would no longer justify the name of ' Wild Life Sanctuary.' (2) Both establish and publicize rules and regulations prohibiting unauthorized personnel to enter the forests of the sanctuary. Only bona fide visitors or those engaged by the Forest Department should be allowed off the sanctuary's main roads. (3) Vehicles should be prohibited from travelling on the sanctuary's roads at night. Periodic checks should be made of all vehicles leaving the sanctuary.

Domestic livestock grazing in the Nagerhole Wild Life Sanctuary, except in areas adjacent to villages, does not appear as yet to be excessive. Nevertheless, now is the time for definitive measures to be taken to ensure that this sanctuary does not become a victim of the almost universal practice in India of overgrazing. All too many of this nation's wild life sanctuaries and areas once abundantly rich in wild life have been almost completely devastated by this abuse, often within the space of a few short years. By no means whatever should livestock grazing be permitted in an area designated as a 'sanctum sanctorum.' In fact, a sanctuary devoted to the preservation of wild life ideally would have no domestic livestock whatsoever within its confines. However, if it is not possible to maintain an area inviolate to such use, grazing and livestock numbers at least should be controlled so as to ensure that suitable forage is produced on a sustained yield basis. There is no excuse for land abuse through overgrazing by domestic livestock. Proper land management will benefit both the wild life and the livestock, as well as the people concerned and the nation as a whole.

## V. THE VENU GOPAL WILD LIFE PARK BANDIPUR SANCTUARY)

### INTRODUCTION

The 22-square-mile Bandipur Sanctuary, which forms a part of the 310-square-mile Venu Gopal Wild Life Park, is undoubtedly the best known of the wild life areas in Mysore State. This notable park was established in 1941 and the Bandipur Sanctuary was constituted as its 'sanctum sanctorum'—an inviolate sanctuary within a sanctuary. The northern and eastern boundaries of the Park are formed by demarcated forest lines. The Park extends to the Kabini River on the west and the southern boundary is formed by a number of streams and the Kerala and Madras State lines (Map 3). The adjoining portion of Kerala, which is in the Wynaad District, also has been proposed as a wild life sanctuary. With the necessary action being taken by the State of Kerala, this tri-State region could become one of the most notable, as well as most extensive, wild life conservation areas in India.

The village of Bandipur is the main tourist centre in the Venu Gopal Wild Life Park. It is situated on the main road midway between the city of Mysore and Ootacamund, approximately 50 miles from either place. The nearest airport is at Bangalore, 86 miles north-east of the city of Mysore. The journey from Bangalore to Mysore may be made by bus or train and frequent buses are available to Bandipur from either Mysore or Ootacamund. A truck, which seats 12 passengers, and two riding elephants are provided at Bandipur by the Forest Department to take visitors into the sanctuary. Visitors with their own vehicles must be accompanied by a member of the staff before they are permitted on the Park's roads.

Over 80 miles of Forest Department roads connect the waterholes, salt licks and game paths within the 22-square-mile Bandipur Sanctuary. The remainder of the Park is served by an additional 80 miles of fair-weather roads. A network of fair-weather roads also connects the Venu Gopal Park with the Nagerhole Wild Life Sanctuary north of the Kabini River. During the dry season one may travel on forest roads all the way from Bandipur to Nagerhole, a distance of approximately 70 miles, and forest lodges are situated conveniently at 8 to 10-miles intervals along the entire route.

The wild life seasonally migrates from Venu Gopal to the lower or greener areas in Kerala and the Mudumalai Wild Life Sanctuary in Madras. Most of the larger mammals, such as elephant and gaur, generally leave the Park during November and December. Depending upon the onset of the south-west monsoon rains, they generally begin their return journey in late May or early June.

The best time to see wild life in Venu Gopal or the Bandipur Sanctuary is from late June through October, which is the rainy season. Nevertheless, the Sanctuary is open and accessible throughout the year and generally some wild life may be seen all the year round. If a visitor is disappointed in the number of wild animals seen in Bandipur area, he may always visit the adjoining Mudumalai Wild Life Sanctuary. The poorest time to see wild life in Venu Gopal is the best time to see wild life in Mudumalai and vice versa.

Bandipur is the only village within the confines of the Venu Gopal Wild Life Park. This village was formerly little more than a forest camp in which were located quarters for the Park staff and forest rest houses for visitors. The Social Welfare Department, however, recently established a tribal village and has constructed school buildings at Bandipur. There is little work available inside the Park for the more than 200 tribal people presently living at Bandipur. Also, there are schools four miles north and five miles east of Bandipur, which are both outside the Park. It is regrettable that the Social Welfare Department has intruded upon the Park, especially when facilities such as schools in nearby areas could have been utilized and when the people resettled here must be maintained on welfare.

The Mysore State Wild Life Board has moved that a township be not established at Bandipur and that the tribal people be resettled elsewhere outside the Park. Action on the Board's proposal is pending and it is to be hoped that measures will soon be taken to correct the present situation. The buildings thus vacated could be utilized to accommodate the ever-increasing numbers of visitors to Bandipur. For example, in 1963 the Bandipur Sanctuary had a total of 2,521 visitors, but in 1965 there were 5,406. An even greater increase in the number of visitors could be realized if suitable facilities were made available so that bus tours could be regularly scheduled to the Park and large groups could be accommodated.

Domestic livestock grazing is not permitted in the Bandipur Sanctuary. Inroads are being made, however, in the northern part of the Park by ever-increasing numbers of livestock. Herders are encroaching deeper and deeper into the Park. As a result, the northern part of the Park is already severely overgrazed and almost completely devoid of wild life. Now is the time to take definitive measures to ensure that Venu Gopal does not meet the same fate as all too many other wild life sanctuaries in India. Limits and boundaries must be set and defined, as well as strictly maintained. Also, number of livestock must be controlled in those areas where grazing is permitted. Otherwise, the Venu Gopal Wild Life Park faces a very bleak and barren future and very shortly it may become almost impossible to maintain even the Bandipur Sanctuary inviolate to the cancerous blight of overgrazing.

Domestic livestock grazing in the vicinity of Bandipur village also is a problem. This would be reduced considerably if the tribal people inhabiting the village were resettled elsewhere. Nevertheless, measures should be taken to control grazing in this area and to maintain livestock numbers at a minimum. Hundreds of head of decrepit, mangy and famished cattle are driven regularly through Venu Gopal to Kerala, where they are slaughtered. These animals supposedly, are restricted to the main road and are not permitted to remain inside the Park overnight. However, the passage of these animals causes a disturbance inside the Park, and possessing daily grazing licences, it is not uncommon to observe them grazing inside the forest, and all along the roadsides. One group was observed to spend the night on the southern boundary of the Park, near the State border at Kakkanahalla. Permitting of such cattle to graze should be discontinued.

In addition to habitat destruction, the poisoning of wild life also has become associated during recent years with domestic livestock grazing in many parts of India. Villagers have found that certain pesticides are very effective for killing wild animals. Generally these pesticides are distributed to farmers by the Agriculture Department for the control of insects. However, they are often used for purposes other than that which they were intended. When a domestic animal dies or is killed by a large carnivore such as a tiger, the carcass is often sprinkled with toxic materials. 'Folidol', for example, is both tasteless and odourless, as well as extremely toxic. Therefore any animal feeding upon a bait containing this chemical usually dies a very agonizing death within a few hours.

Two tigers (a male and a female) were killed by a poisoned bait along the northern boundary of the Venu Gopal Wild Life Park in October, 1965. The skin of the tigress is presently on display in one of the forest rest houses at Bandipur. The hide of the male had spoiled before the carcass was found. A leopard was similarly killed on Chamundi Hill outside the city of Mysore in 1963, and a few tigers were poisoned in the Chennagiri area in the Shimoga District of Mysore in 1962. In all these cases the culprits were not traced, nor did the owners come forward to claim the poisoned carcasses. No prosecution, therefore, could be attempted. Besides these confirmed reports, there are undoubtedly many more cases where pesticides have been used to poison wild life in Mysore and other states. Measures must be taken soon to halt such practices or an important part of India's once rich wild life heritage may become extinct in perhaps less than a decade.

Sixteen tiger blocks, varying in size from 50 to 100 acres each, are maintained north of the Venu Gopal Park. Prior to 1962 an average of 5 or more tigers were shot each year on these blocks. However, with the widespread use of toxic pesticides, only one tiger has been shot in this

entire area since 1962. Mysore once was world renowned for its vast numbers of tigers and its elaborate tiger shoots. But in 1965 even the Maharaja of Mysore, who is also the Governor, had to go outside the State in order to bag a tiger.

The mating season for tigers in the Venu Gopal Park is during November and December. The Park staff claimed that in former years tigers frequently could be heard roaring during these months. However, no roaring of tigers has been heard in the Park since 1964. Not even pug marks had been observed in the Park during the months prior to my visit in November, 1966.

Immediate steps should be taken to ensure that toxic materials are used only for the purpose for which they were originally intended. Farmers should be given specific instructions as to the use of all pesticides made available to them, as well as severe penalties imposed upon those who misuse them. Also, whenever possible, materials which are less toxic to wild life should be used in preference to highly toxic ones. In fact, less toxic pesticides are often superior in all ways to the more toxic ones presently being used in India. For example, Malathion is considered superior in many ways to the more toxic Enderin and Parathion. Enderin in considered so highly toxic that in many modern countries its distribution and use are prohibited. Finally, pesticides should be treated with additives that give them both a distinct odour and an undesirable taste. This would help to protect both man and beast, as pesticides also have been used in an ever-increasing number of homicides in India.

## Visitor Facilities

Visitor activities in Venu Gopal generally centre at the village of Bandipur and the Bandipur Sanctuary, although there are forest lodges situated throughout the Park. The four Forest Rest Houses at Bandipur (2 with 3 suites and 2 with 2 suites) provide full board and lodging and can accommodate a total of 20 people. The Forest Department plans to provide additional facilities in the near future so that groups of up to 50 people may be accommodated at Bandipur. Reservations for accommodation may be made through either the Divisional Forest Officer, Mysore Division, Mysore, or the Wild Life Officer in Mysore.

Besides the rest houses at Bandipur, there are nine forest lodges in or near the Venu Gopal Wild Life Park. Although some of these lodges are fully furnished, boarding and other facilities are not provided. Others provide only shelter and some of the basic amenities for visitors wishing to remain inside the Park. Forest lodges are situated at the following locations : Gopalswami Betta along the northern boundary, Chammanhalla on the western edge of the Bandipur Sanctuary, Mulehole

on the bank of the Nugu River on the State border near the southern boundary of the Park, Kalkere and Choudahalli near the south-western limits in the interior, Gundre in the south-western corner of the Park near the Kabini River, Chiekbergi in the centre of the Park, Hediyala along the central part of the Park's northern outskirts on the Sunnadabegur-Hunsur road, and Begur on the banks of the Kabini River near the north-eastern corner of the Park.

The Venuvihar Forest Lodge is located at Gopalswami Betta, a hill station 13 miles north-west of Bandipur. The lodge has two fully furnished suites, but other facilities are not provided. The Venu Gopal Temple, from which the Park received its name, is adjacent to the lodge. Venu Gopal literally means flute—(Venu), Krishna (Gopal). Krishna is one of the major Hindu deities or gods. A priest is stationed at the temple and people frequently come here to worship. The lodge and temple are situated on top of a 4,769-foot hill, which offers visitors an impressive panorama of the Park, the 8,000-foot Nilgiri Hills to the south and the lowlands to the north. There are a number of paths leading from the lodge, a pleasant juniper grove, and during certain seasons the surrounding hills are covered with the blossoms of wild flowers.

The Chammanhalla Forest Lodge is 11 miles west of Bandipur. Although it is in need of renovation, it provides shelter and some of the basic amenities for visitors. The Mulehole Forest Lodge is 18 miles west of Bandipur and the Forest Department has proposed that it be renovated and established as a tourist centre similar to Bandipur. Mulehole is on the main road between Gundlupet and Calicut and is reached easily from either Mysore or Ootacamund.

The Kalkere Forest Lodge is 10 miles west of Mulehole, the Choudahalli Forest Lodge another nine miles, and the Gundre Forest Lodge an additional eight miles or a total of 27 miles west of Mulehole. The Hediyala Forest Lodge is 16 miles north of Mulehole and is located outside the Park's boundaries. The Begur Forest Lodge is eight miles north of Choudahalli or nine miles north of Gundre and also is outside the Park.

There are a number of machans or observation towers overlooking water holes or salt licks in the Bandipur Sanctuary. Some of these are constructed so that visitors may spend the night in them in relative comfort. Inside the sanctuary, about a mile west of Bandipur next to the Tavarekatte Tank, is a well laid-out tiger block with a comfortable hide. A bare sandy road surrounds the block and whether or not a tiger is inside the block can be determined by examining the road for pug marks. Some excellent results were obtained in photographing tigers from the hide in this block in years past. However, with the introduction of toxic pesticides outside the sanctuary and the accidental burning of the

block by those removing the bamboo, which died in 1964, there has been little evidence of tiger in this area during the past two years.

## Habitat

The terrain consists primarily of rolling hills covered with open or park-like dry deciduous forests. The altitude varies between 3,100 feet (945 metres) above sea-level along the Moyar River on the southern boundary to 4,769 feet (1,454 metres) at the Gopalswami Betta Hill Station along the northern boundary. Bandipur village is 3,366 feet (1,026 metres) above sea-level. Temperatures vary from a monthly minimum mean of 60° F. (15·6° C.) in January to a monthly maximum mean of 95° F. (35·0° C.) during April and May. April and May are also the driest and the poorest months to observe wild life. Late June through October (the rainy season) is the best time to see wild life in Bandipur. Total rainfall averages about 35 inches per annum, most of which occurs during July, August and September.

### Flora

The trees of Bandipur Sanctuary are spaced in a relatively uniform manner and form an open, pole-type, mixed dry deciduous forest with a maximum height of between 50 and 60 feet. Visibility varies between 100 and 200 yards and the understory is mostly grasses with a few scattered shrubs. The grass attains a height of three to six feet and controlled burning by the Forest Department is done each year between the third week of December and the second week of January. This prevents the dry grass from becoming a major fire hazard during the drier months of the year and also helps to return the nutrients from the unpalatable dry grass to the soil.

*Eupatorium glandulosum*, the noxious weed that has taken over much of the Nagerhole Wild Life Sanctuary to the north, has not yet invaded the Bandipur area. However, its counterpart, *Lantana camara*, is fairly common. A breakdown of the dominant tree species in the forest of Venu Gopal is given in Table 2.

Both species of bamboo in the Park (*Bambusa arundinacea* and *Dendrocalamus strictus*) flowered during July and August 1964 and then died. Big bamboo usually flowers every 40 to 50 years, while small bamboo flowers every 10 to 20 years. It was claimed that normally about 60% of the bamboo in the Park is big bamboo and the remaining 40% small bamboo, but there were only scattered sprouts present during my visit. After the die-off, the bamboo presented a fire hazard. Therefore the Forest Department decided to sell the dead bamboo to the rayon mills in Kerala. However, besides causing considerable disturbance, the

workers removing the bamboo accidently set fire to the area. Consequently, rather than realizing a profit the Forest Department suffered a considerable loss. As a result, parts of the sanctuary which were formerly under bamboo, such as the Tavarekatte Tiger Block west of

TABLE 2

SPECIES COMPOSITION OF THE MIXED DRY DECIDUOUS FORESTS OF BANDIPUR SANCTUARY IN THE VENU GOPAL WILD LIFE PARK IN MYSORE STATE

| English Name | Local or Kanarese Name | Scientific Name | Percent of Stand (Estimated) |
|---|---|---|---|
| *TREES*: | | | |
| Axlewood | Dindaga, Dindal, Bejjalu | *Anogeissus latifolia* | 60% |
| Teak | Tega, Sagavani | *Tectona grandis* | 5 |
| ——— | Bende | *Kydia calycina* | 5 |
| ——— | Jalari | *Shorea talura* | 5 |
| Wild Gooseberry | Nelli | *Phyllanthus emblica* | 3-4 |
| ——— | Challe (fruit) | *Cordia myxa* | 2 |
| ——— | Doddi | *Mymenodictyon excelsum* | 2 |
| Bobbinwood | Yethyaga, Yethaga | *Adina cordifolia* | 2 |
| ——— | Muthuga | *Butea monosperma* | 2 |
| ——— | Alale | *Terminalia chebula* | 2 |
| ——— | Hunnal (Hunal) | *Terminalia paniculata* | 2 |
| ——— | Mathi | *Terminalia tomentosa* | 2 |
| ——— | Kakke | *Cassia fistula* | 2 |
| Rosewood | Beete | *Dalbergia latifolia* | 1 |
| ——— | Nelagodda, Godda (fruit tree) | *Garuga pinnata* | 1 |
| Jamun tree | Nerale | *Eugenia jambolana* | 1 |
| ——— | Jagalaganti (edible fruit) | *Diospyros montana* | 1+ |
| ——— | Tadusalu, Tadsal (bark eaten by elephants) | *Grewia tiliaefolia* | 1 |
| ——— | Kuli, Sivani (fruit) | *Gmelina arborea* | 1 |
| ——— | Kadusige (fodder) | *Acacia intsia* | 1 |
| ——— | Basavan apuda | *Bauhinia racemosa* | 1 |
| Silk Cotton | Buruga | *Salmalia malabaricum* | 1 |
| ——— | Tare | *Terminalia belerica* | 1 |
| *UNDERSTORY*: | | | |
| Big Bamboo | Bombu | *Bambusa arundinacea* | 1 |
| Small Bamboo | Kiribidaru | *Dendrocalamus strictus* | 1 |
| ——— | Seema-seege | *Lantana camara* | common |

Note :

1. Both the big and small bamboo flowered and died during the fall of 1964. Therefore, the numerous shoots present were considered as a part of the understory.

2. Grasses, herbs, and shrubs were not identified.

Bandipur, have been replaced by weeds and dense thickets of *Lantana camara*.

**Fauna**

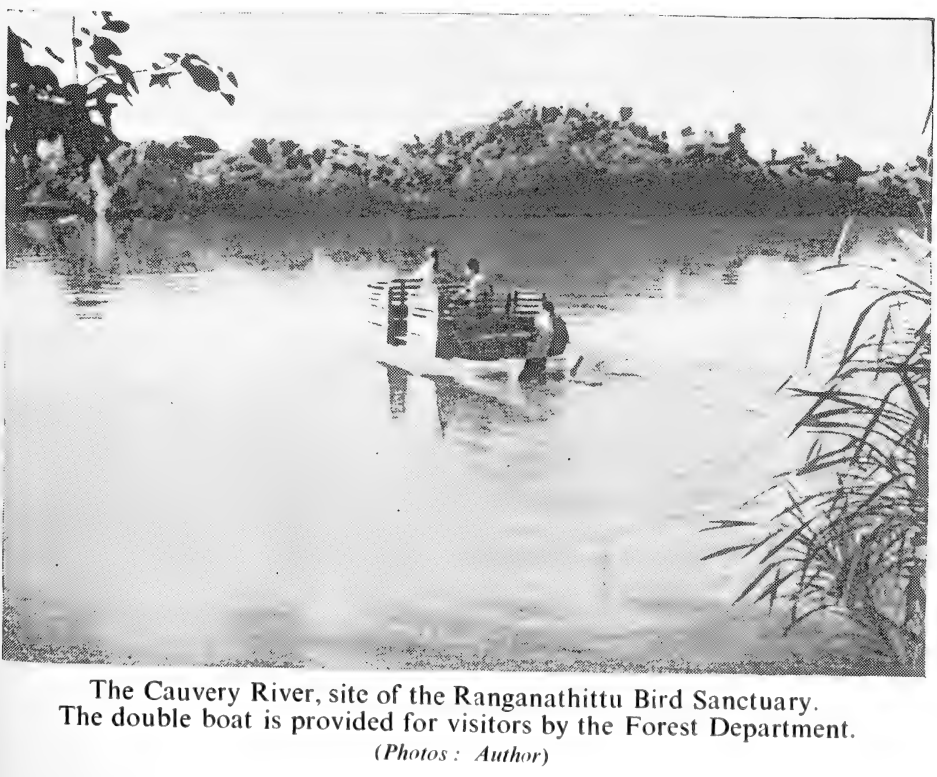
The fauna of the Venu Gopal Wild Life Park is notable both for its diversity and abundance. Although the mammalian fauna is similar to that of much of the Western Ghat region, in India one rarely sees greater concentrations of wild animals than in Bandipur and the adjoining Mudumalai Wild Life Sanctuaty. Herds of 20 or more gaur, the largest and most impressive of the world's wild bovines, are common. The forest dwelling sambar may be encountered in groups of up to a dozen, whereas generally they are considered a somewhat solitary animal. Groups of over a hundred chital may be observed even in the vicinity of the forest rest houses at Bandipur (Plate I). Wild elephant, particularly solitary males, are observed by most visitors (Plate II). It appears that Venu Gopal serves as a breeding ground for most of the large mammals of this region. This is due perhaps to the Park's relative immunity to the disturbances of man. Some of the mammals inhabiting Venu Gopal and the forests in western Mysore are given in Table 3.

TABLE 3

NAMES OF SOME OF THE MAMMALS INHABITING THE VENU GOPAL WILD LIFE PARK (BANDIPUR SANCTUARY) AND THE FORESTS IN THE WESTERN PART OF MYSORE STATE

| English | Local or Kanarese | Scientific | Relative Abundance |
|---|---|---|---|
| Tiger | Hebbuli | *Panthera tigris* | rare |
| Leopard or Panther | Kiruba | *Panthera pardus* | rare |
| Jungle Cat | Kādubekku | *Felis chaus* | frequent |
| Striped Hyena | Kathekiruba | *Hyaena hyaena* | rare |
| Wild Dog or Dhole | Seelunayi | *Cuon alpinus* | occasional |
| Jackal | Gullenari | *Canis aureus* | common |
| Indian Fox | Kankanari | *Vulpes bengalensis* | frequent |
| Little Indian Civet | Punagina bekku | *Viverricula indica* | occasional |
| Mongoose | Mungusi | *Herpestes* spp. | common |
| Sloth Bear | Karadi | *Melursus ursinus* | rare |
| Wild Boar | Kādhandi | *Sus scrofa* | common |
| Sambar | Kadave | *Cervus unicolor* | common |
| Chital or Spotted Deer | Saraga | *Axis axis* | common |
| Barking Deer or Indian Muntjac | Khānkuri or Kādukuri | *Muntiacus muntjak* | infrequent |
| Mouse Deer or Indian Chevrotain | Burkanabekku or Burka | *Tragulus meminna* | frequent |
| Chousingha or Four-horned Antelope | Chyale | *Tetracerus quadricornis* | rare |
| Gaur or Indian 'Bison' | Kāti or Kādukōna | *Bos gaurus* | common |
| Indian Elephant | Ane | *Elephas maximus* | common |
| Common Hare | Mola | *Lepus nigricollis* | frequent |
| Indian Porcupine | Mulluhandi | *Hystrix indica* | common |
| Small Travancore Flying Squirrel | Hāranabekku | *Petinomys fusccapillus* | frequent |
| Giant or Malabar Squirrel | Kendalilu (Karrat) | *Ratufa indica* | common |
| Common Langur | Musiya | *Presbytis entellus* | common |
| Bonnet Macaque | Kapi | *Macaca radiata* | common along the road from Mysore, but not inside the Park. |

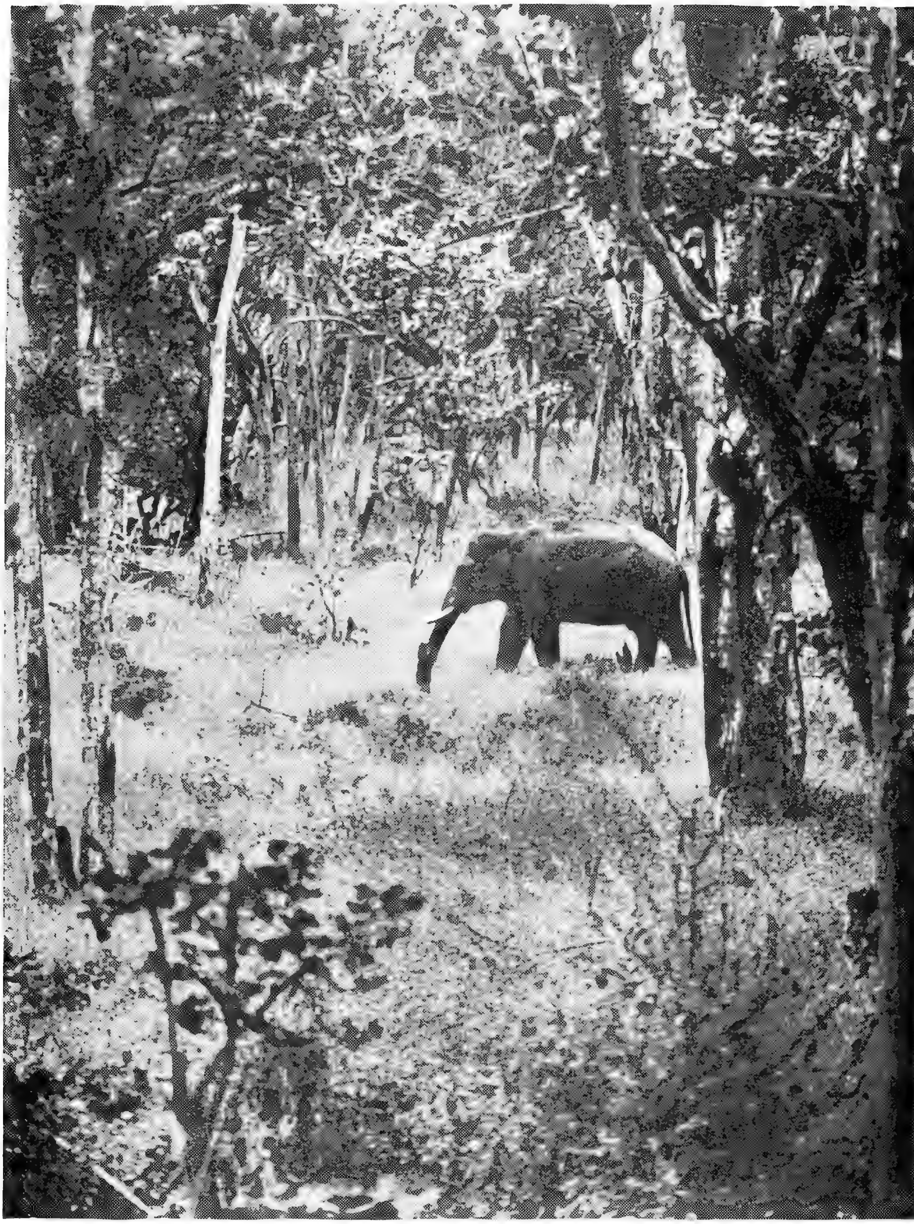
Two female spotted deer or chital in the vicinity of the Bandipur Forest Rest House in the Venu Gopal Wild Life Park in Mysore State.



The Cauvery River, site of the Ranganathittu Bird Sanctuary. The double boat is provided for visitors by the Forest Department.

*(Photos: Author)*

Spillett: Wild Life Surveys



A solitary tusker in the forests of the Bandipur Sanctuary of the Venu Gopal Wild Life Park in Mysore State.

(*Photo : Author*)

The possibility of seeing the much maligned dhole or Indian wild dog is better perhaps in Venu Gopal than anywhere in India. This beautiful, bright red animal runs in packs and is infamous for wantonly attacking almost any animal which it may encounter, including even tiger according to some claims. Because of its notoriety the dhole has been persecuted unmercifully throughout India and as a result has become exceedingly rare. Although I have visited a good number of India's wild life areas, I had the unforgettable experience of seeing the dhole for the first time during my visit to Venu Gopal.

We were travelling along the roads in the Bandipur Sanctuary the morning of November 29 when we suddenly heard the repeated belling and squeals of sambar. Two adult females and a fawn of about two months were standing in a couple of feet of water in the middle of an artificial waterhole or tank. A pack of about 15 dhole had surrounded the tank and their heads kept bobbing up through the high grass as they attempted to observe their prey. Although the wild dogs appeared to be very excited, they did not utter a sound. Upon seeing us the sambar bolted, but they had no more than reached the bank before one of the dogs was upon the fawn and pulled it down into the grass. The fawn was emitting high pitched squeals and the two does repeatedly belled nearby. Still we heard no sound from the dholes. We ran towards the fawn, which was kicking and struggling in the grass. When the wild dogs saw us, they immediately took flight and the last we saw of them were their black-tipped tails as they bounded through the grass. The fawn had only a few superficial wounds, but was too weak to stand. Therefore, we took it back to Bandipur with us. Within a short time it appeared to have fully recuperated and was released back into the forest the following day.

The bird life of the Venu Gopal Park also is abundant and diversified. Water birds such as ducks, egrets and herons are found in some of the tanks but the vast majority of the birds in the Park are perching or passerine forms. Some of the more common or obvious birds which I observed during my visit are listed in Table 4.

## Discussion

The Venu Gopal Wild Life Park and the Bandipur Sanctuary constitute one of India's outstanding wild life attractions. The Forest Department and the Park staff are to be commended for their management and development of this notable area. Granted there are problems to overcome and much to be done before the Park will begin to realize its full potential. The Forest Department and those concerned are aware of these, but oftentimes they lack the means and/or the support to accom-

plish the desired goals involved in the conservation of this great nation's wild life resources.

TABLE 4

SOME OF THE MORE COMMON BIRDS OBSERVED IN NOVEMBER, 1966 IN THE VENU GOPAL WILD LIFE PARK IN MYSORE STATE

| English Name | Scientific Name |
|---|---|
| Cattle Egret | *Bubulcus ibis* |
| Little Egret | *Egretta garzetta* |
| Lesser Whistling Teal | *Dendrocygna javanica* |
| Spotbill Duck | *Anas poecilorhyncha* |
| Common Pariah Kite | *Milvus migrans* |
| Brahminy Kite | *Haliastur indus* |
| Grey Partridge | *Francolinus pondicerianus* |
| Jungle Bush Quail | *Perdicula asiatica* |
| Red Spurfowl | *Galloperdix spadicea* |
| Grey Junglefowl | *Gallus sonneratii* |
| Peafowl | *Pavo cristatus* |
| Redwattled Lapwing | *Vanellus indicus* |
| Green Pigeon | *Treron phoenicoptera* |
| Blue Rock Pigeon | *Columba livia* |
| Ring Dove | *Streptopelia decaocto* |
| Spotted Dove | *Streptopelia chinensis* |
| Parakeets | *Psittacula* ssp. |
| Crow-Pheasant | *Centropus sinensis* |
| Spotted Owlet | *Athene brama* |
| Whitebreasted Kingfisher | *Halcyon smyrnensis* |
| Bluecheeked Bee-eater | *Merops superciliosus* |
| Green Bee-eater | *Merops orientalis* |
| Blue Jay or Roller | *Coracias benghalensis* |
| Common Gray Hornbill | *Tockus birostris* |
| Goldenbacked Woodpecker | *Dinopium benghalense* |
| Golden Oriole | *Oriolus oriolus* |
| Racket-tailed Drongo | *Dicrurus paradiseus* |
| Common Myna | *Acridotheres tristis* |
| Jungle Crow | *Corvus macrorhynchos* |
| Redwhiskered Bulbul | *Pycnonotus jocosus* |
| Whitecheeked Bulbul | *Pycnonotus leucogenys* |

The mixed dry deciduous forests of the Bandipur area are of little commercial value for timber. Although they are of some value for firewood, demands for such products can be met from forest areas closer to market or by the planting of fast growing species on submarginal lands. Therefore, it has been proposed that the Park's 'sanctum sanctorum'—the Bandipur Sanctuary—be enlarged from 22 square miles to 60 square miles. This would include the entire portion of the Park east of the Gundulupet-Calicut road. It has been further proposed that the Mulehole Forest Lodge, which then would be on the western end of the sanctuary, be renovated and established as a tourist centre similar to Bandipur.

The best time for observing wild life in Bandipur is during the rainy season. However, it is during this season that it is most difficult to travel

the fair-weather roads in the Sanctuary. Thus it has been proposed that the major roads in the Sanctuary, as well as the main forest road from Bandipur to the Nagerhole Wild Life Sanctuary, be metalled. I would not suggest tar roads or that major thoroughfares be developed, but only that two metalled tracks be constructed. Grass in the centre, as well as along the sides of such roads, would present a natural setting while helping to minimize maintenance. Concrete aprons also should be provided at stream beds wherever possible.

The construction and maintenance of a good network of all-weather roads also would result in increased use of the Park's forest lodges. Plans should therefore be formulated for the renovation and maintenance of these. Additional accommodations likewise are needed at Bandipur. I would suggest that the present forest rest houses be maintained as first class facilities, but that a dormitory be provided for the accommodation of large groups. The attractions and amenities of Bandipur should be extensively advertised through posters, pamphlets, and so forth. Arrangements also should be made through the Tourist Department to provide regularly scheduled bus tours to Bandipur. Care, however, should be taken to avoid commercialism within the Park.

The Mysore and Madras Forest Departments have jointly approved the construction of a dam on Kakkanahalla, which forms a part of the boundary between the Bandipur and Mudumalai sanctuaries. The impounded waters would form about a 1-mile-square lake. This would provide a source of water for wild life and perhaps would encourage animals to remain in this area the year round. Although fair numbers of chital and sambar remain in Bandipur throughout the year, most of the other animals move out of the Sanctuary when the streams and artificial water holes become dry.

Major problems presently confronting the Venu Gopal Park and its wild life are : The establishment of a tribal colony at Bandipur, increased pressures upon the Park from domestic livestock grazing, and the use of pesticides for poisoning wild life. These have been discussed at some length in the Introduction. Poaching does not appear to be a major problem in the Park. This perhaps is attributable to the wise practice of not allowing vehicles on the Park's roads unless they are accompanied by a member of the staff. The checkpoint on the Mysore-Madras line along the main road passing through Bandipur also probably helps to deter illicit activities.

## VI. THE CHAMARAJANAGAR WILD LIFE PRESERVE

Chamarajanagar was established in 1931 as Mysore's first wild life sanctuary. However, with the establishment of the Venu Gopal Wild Life Park in 1941, the status of Chamarajanagar was reverted to that of

a wild life preserve. It has since been realised that Chamarajanagar forms a very important link in the chain of wild life sanctuaries extending along the southern and western boundaries of Mysore State. Thus, the Forest Department has proposed that a wild life sanctuary again be established in this area.

Mr. P. M. Monnappa accompanied me from Mysore to Chamarajanagar, a distance of 38 miles, on the morning of November 27. *En route* we passed through Somnathpur and saw the impressive Hoysala Temple. We were met in Chamarajanagar by the Divisional Forest Officer, Mr. Alva, who accompanied us on a tour of the proposed wild life sanctuary.

I was much impressed with what the Chamarajanagar area has to offer. East of the town of Chamarajanagar the Biligirirangan Hills suddenly jut out from the plains below. Winding up into the hills on a well-constructed road, one passes from a scrub forest into a dry deciduous forest, to a moist deciduous forest and from there into a semi-evergreen forest. In addition, pure stands of evergreen forest were observed along the streams and on the slopes near the crests of some of the higher hills.

We stopped briefly at Kyathadeveraguda, which is situated in a saddle of the Biligirirangan Hills 18 miles east of Chamarajanagar. There are two large rest houses at Kyathadeveraguda : a Forest Rest House with three suites, reservations for which can be obtained by writing to the D.F.O. in Chamarajanagar, and a Public Works Department Rest House with four suites. The view from both rest houses is magnificent. The green plains, bejewelled with numerous shimmering tanks, extend north and west to the horizon. One can even see the Kabini River and Chamundi Hill in the distance. To the south and east are rows of verdant, mist covered hills.

The Biligiri Ranganaswamy Temple is 12 miles east of Kyathadeveraguda. This approximately 900-year-old temple is located on a rocky pinnacle, which has a sheer face with a drop of several hundred feet. A modern sericultural research station is located in the forests below. Also *en route* from Kyathadeveraguda to the Biligiri Temple one passes the ancient Gangadeswara Temple, which is situated along a forest stream and is inhabited by a troop of bonnet macaques.

The Government is attempting to establish the Biligiri Ranganaswamy Temple as a tourist centre. Electric power lines were brought through the forest in 1966 and several rest houses have been built adjacent to the temple. The forest roads on both sides of the temple are being metalled and a new road is being constructed from Yalendur to the north-west.

The establishment of a true wild life sanctuary in this area, adjoining Chamarajanagar Wild Life Preserve, would greatly add to the attraction of the Government sponsored tourist centre at the Biligiri Rangana-

swamy Temple. In addition to the rest houses already mentioned, there are forest lodges located in the proposed sanctuary area at Beduguli and Budipadaga. The area is served by a good network of roads, which are being maintained and improved. Also, what is most important is that the area has the potential of becoming one of India's outstanding wild life sanctuaries.

The Biligirirangan Hills form a natural passageway for elephant herds moving to and from the hill areas to the east and the Bandipur and Mudumalai wild life sanctuaries to the west. J. P. Sanderson recognized this fact and it was here in the mid-1800's that he developed the khedda method for capturing wild elephants. The dense forests, lush grass, and numerous plots of bamboo also make this area a rendezvous site for elephant, as well as a choice habitat for gaur, sambar, chital, and other wild life species. Even during our short visit we saw gaur, chital, and sambar while driving along the main roads.

The Forest Department's proposal to establish Chamarajanagar and Biligiri Ranganaswamy Temple Forests as a wild life sanctuary should be enacted as soon as possible. Not only should this approximately 40-square-mile area be constituted as such, but it should also be maintained as an inviolate wild life sanctuary—a true sanctum sanctorum in which people may enjoy nature in as much a pristine state as possible. Most of the forests in this area are of relatively little commercial value, especially when compared to the revenue potential from tourism. Therefore, there is little justification for continued forest operations or other forest exploitation. It is further suggested that the Government and the Forest Department jointly sponsor the development and publicity of both the Government Tourist Centre at the Biligiri Ranganaswamy Temple and the proposed wild life sanctuary.

## VII. OTHER WILD LIFE SANCTUARIES IN MYSORE STATE

### The Dandeli Wild Life Sanctuary

The almost 73-square-mile Dandeli Wild Life Sanctuary was established in 1945 in what was then a part of the State of Bombay, but which is now the North Kanara District of Mysore. The sanctuary, however, has been extensively exploited for forest produce and further disturbed by manganese mining operations. The nearest railway stations are located at Dharwar, about 40 miles from the sanctuary, and at Belgaum, which is about 50 miles away. Buses which pass through the sanctuary, may be taken from these points. There are four forest rest houses in the sanctuary, each with two double suites.

### The Jager Valley and Baba Buddin Wild Life Sanctuary

The 88-square-mile Jager Valley and Baba Buddin Wild Life Sanctuary in the south-western part of the Chikmagalur District was constituted in 1941. The sanctuary includes the backwaters of the Bhadravati Dam, for which the surrounding horseshoe-shaped Baba Buddin hills form the catchment area. The nearest railway station is at Kadur, 51 miles from the sanctuary. Bus services are available from Kadur to Chikmagalur, a distance of 24 miles, but arrangements must be made for a private vehicle to travel the remaining 27 miles to the sanctuary. There are two forest rest houses inside the Sanctuary, but they are in need of repair.

It has been recommended by the Forest Department that Jager Valley and Baba Buddin be included in a newly proposed sanctuary—the Bhadra Wild Life Sanctuary. The proposed sanctuary would encompass a total of 289 square miles in the Chikmagalur and Shimoga Districts and would centre at the Bhadra and Tunga dams.

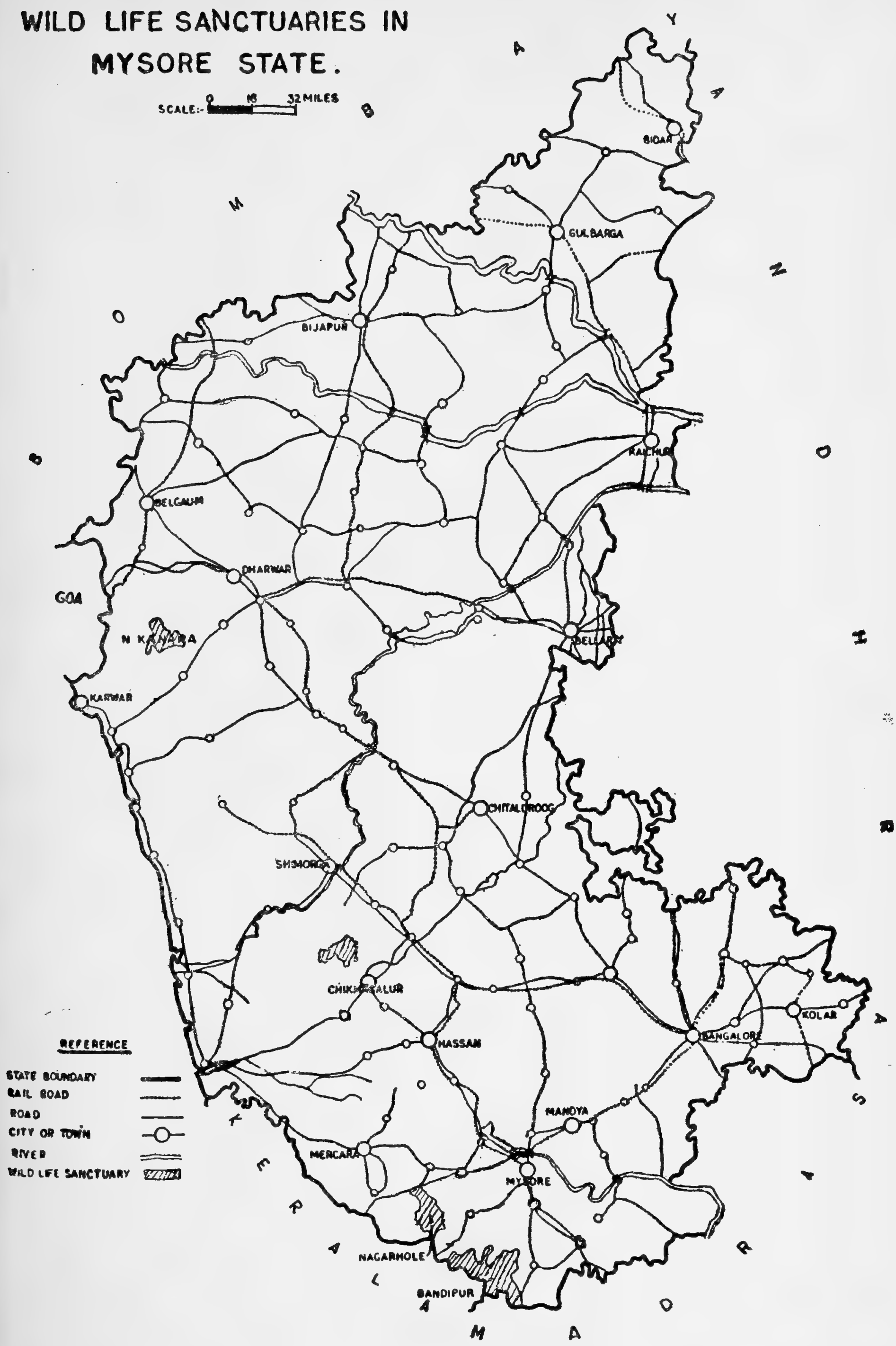
Islands in the impounded waters of these dams offer potential nesting sites for the waterfowl which inhabit this region. The Muthodi area in Chikmagalur District, which is included in the sanctuary, is noted for its herds of gaur. Other animals of note are wild elephants, chital, sambar and tiger.

Visitor facilities already present in the area include forest lodges at Umblebyle Burz, Sukalhatti, Kesare and Muthodi. These are said to be in need of remodelling and the addition of sanitary facilities. Catering services also are lacking at present. After the sanctuary has been established, the Forest Department further proposes that two launches be made available for visitors to visit the islands and from which to view wild life along the shores of the reservoirs formed by the two dams. This method of observing wild animals has proved very successful in the Periyar Wild Life Sanctuary in Kerala. Two jeeps and a lorry also are to be provided for the use of visitors.

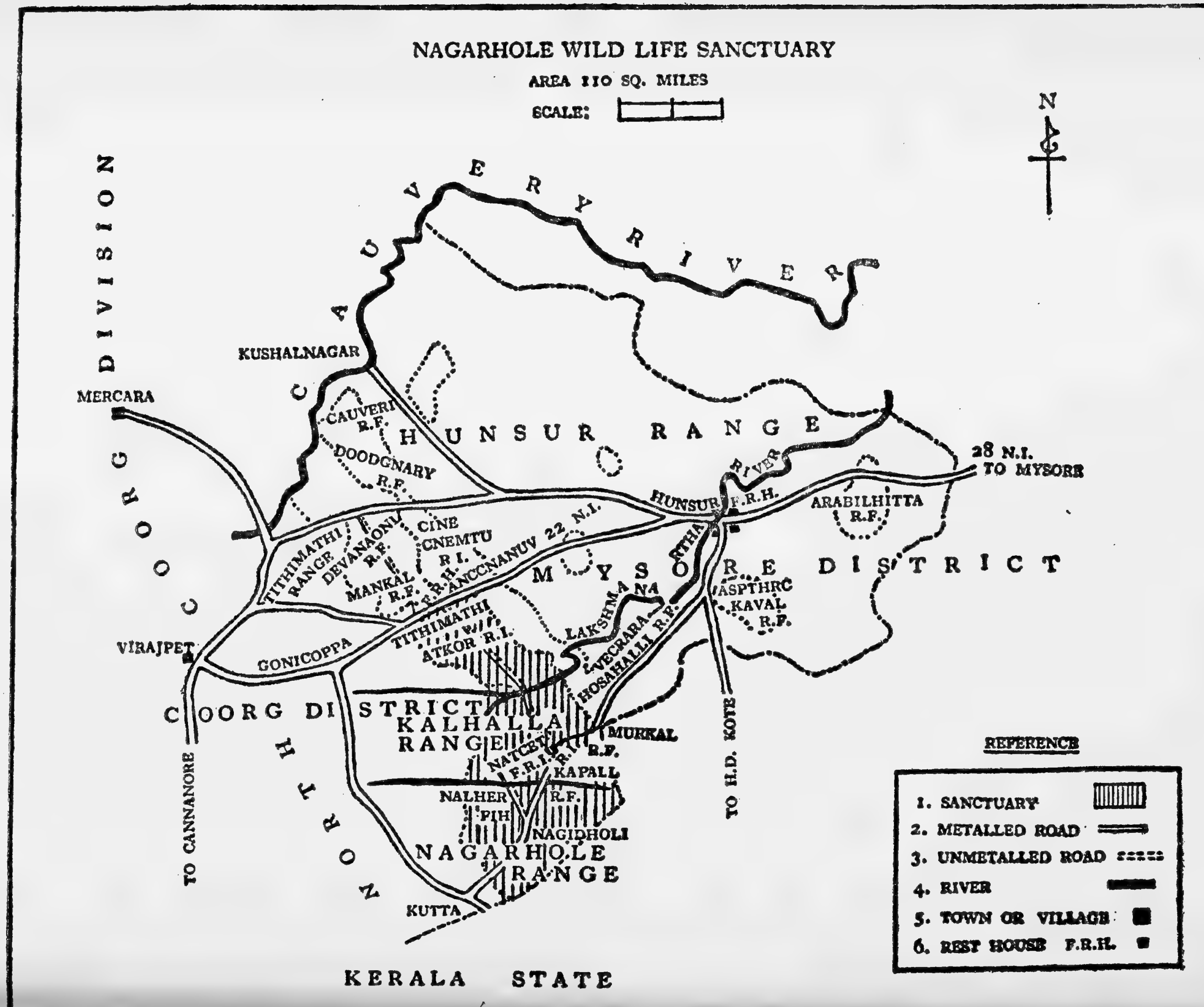
The forests of the proposed Bhadra Sanctuary would consist of both tropical moist deciduous and tropical dry deciduous forests with frequent plots of bamboo. Although forest produce would continue to be exploited, plans entail the establishment of an approximately 25-square-mile sanctum sanctorum.

## VIII. Acknowledgements

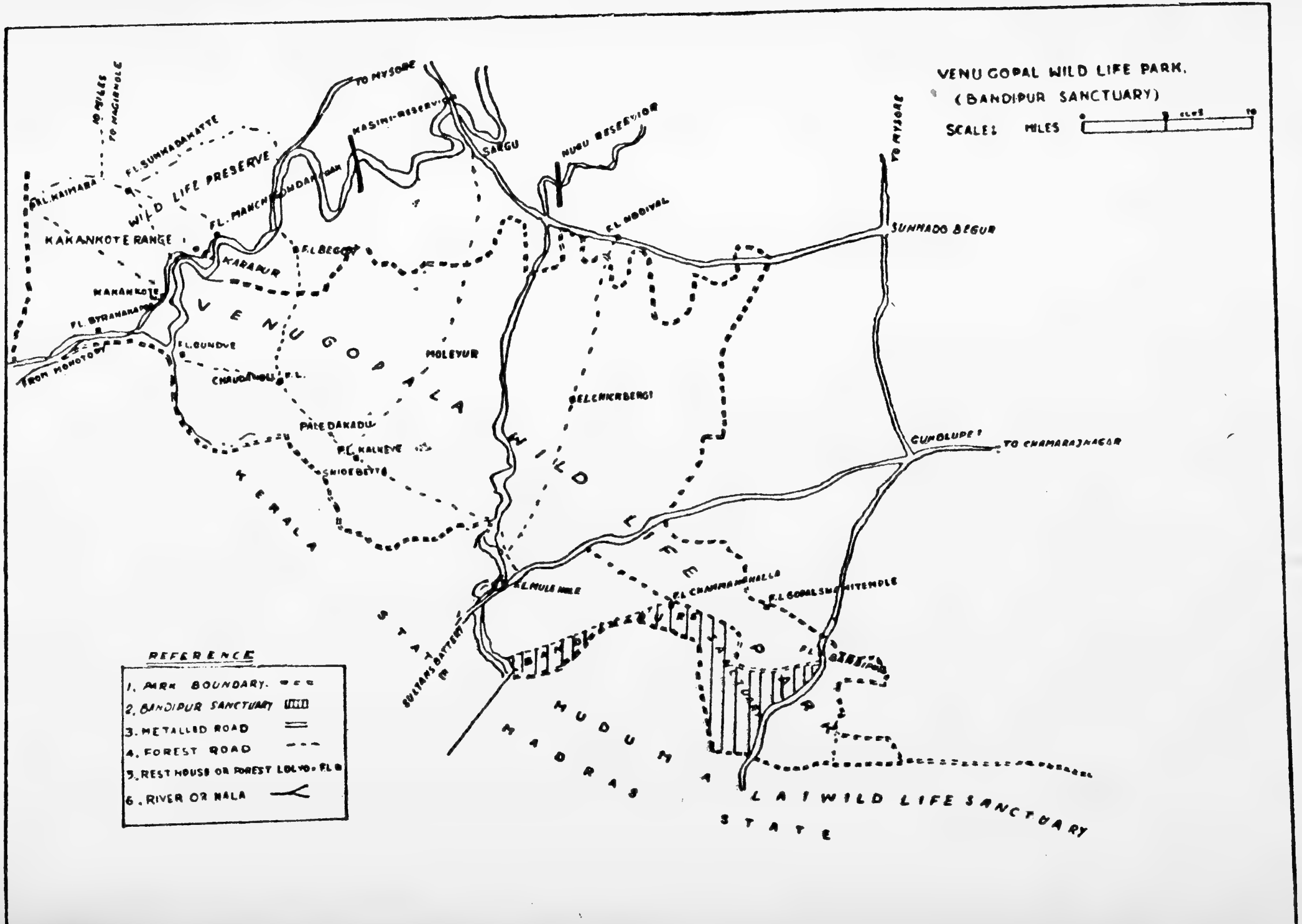
I wish to thank Mr. N. S. Kaikini (Chief Conservator of Forests) and the Forest Department of Mysore for their gracious hospitality and kind assistance during my tour of some of the State's wild life areas. I particularly want to thank Mr. P. M. Monnappa, Wild Life Officer, who




Map 1. Map of the wild life sanctuaries in Mysore State.




Map 2. General map of the Nagerhole Wild Life Sanctuary in Mysore State.




Map 3. General map of the Venu Gopal Wild Life Park, including the Bandipur Sanctuary, in Mysore State.

accompanied and assisted me throughout my 8-day tour, November 22 to 30, 1966. Mr. Monnappa has been associated with the State Wild Life Unit since 1954 and is a member of the game staff for the royal palace. His profound knowledge of wild life and the problems confronting Mysore's wild life resources, as well as his patience in answering my many questions, were invaluable in the compilation of this report. Thanks also are given to the other Forest Department personnel who assisted with this survey and who were so hospitable to me. Regretfully they are too numerous to mention individually here.

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(*to be continued*)

# Nepal Birds: Supplement to Biswas' List

BY

R. L. FLEMING

A comprehensive list of birds from Nepal by B. Biswas of the Zoological Survey of India, Calcutta, appeared in the *Journal* of the Bombay Natural History Society from August, 1960 to December, 1963. Biswas recorded 772 species and sub-species found in Nepal from 1821 to 1959. From the latter year onward, I have continued the study of birds in this country. ' Notes on Nepal Birds ' by Fleming and Traylor, published by the Field Museum in Chicago, appeared in 1961. The next volume, ' Further Notes on Nepal Birds,' by the same authors, came out in 1964. Our third publication is due this year, 1968.

Since 1959 we have added 56 species and sub-species new to the Nepal list. Specimens of these birds, with one or two exceptions, are in the Field Museum in Chicago. We have gone over the excellent list of Biswas and are only able to make three or four corrections or additions. The following data may be helpful to those who have copies of the *Journal* but do not have our publications from the Field Museum.

Someone asked me, after my initial visits to Nepal, beginning in 1949, ' How many kinds of birds are there in Nepal ? ' ' About 700,' I replied. This seemed high as Hodgson's list, according to Ripley[1], was only 563. However, these additions bring the total almost to 830 birds collected, plus authentic sight records of a score or more others.

A great deal of information has been gathered in recent years on birds of this part of the world. We are glad to be able to contribute a little to science in our study of the birds of Nepal.

Our list is as follows :

**Sarkidiornis melanotos** (Pennant). Comb Duck

Some twenty-five birds flew out of a large pond near Dhanghari in the south-western *terai*. I had seen one there fourteen years before. (December, March)

**Buteo vulpinus vulpinus** (Gloger). Desert Buzzard

We collected this species in Kanchanpur District, fifteen miles west of Dhanghari. (January)

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[1] S. D. RIPLEY : 'Peerless Nepal—A Naturalist's Paradise,' *National Geographic Magazine*, Vol. XCVII (1), January, 1950 : 1.

**Aquila pomarina hastata** (Lesson). Lesser Spotted Eagle

Upon re-examining the skin labelled *A. clanga*, Traylor showed that it was really the smaller of two similar eagles. The larger bird was recorded by Hodgson but this species is new to the Nepal list. We took it both in the eastern and western *terai*. (Winter)

**Francolinus francolinus melanonotus** Hume. Assam Black Partridge

A closer inspection by Traylor of skins from central Nepal showed that they were closer to the Assam race than to the western one. Our more recent specimen came from the Rapti Dun. (February)

**Lophura leucomelana hamiltonii** (J. E. Gray). Whitecrested Kalij Pheasant. (No. 128 on Biswas' list)

Our initial record of this bird was a sight record only. Fourteen years later (1965) we got specimens in far western Nepal where it is quite common, ranging as low as 1000 feet to above 6000 feet. (April)

**Rallus aquaticus indicus** Blyth. Water Rail

Ripley did not include Nepal in the area of this rail but he did list nearby East Pakistan. The only time we came across it was on the lower reaches of the Kosi in south-eastern *terai*. (November)

**Rallina eurizonoïdes nigrolineata** (Gray). Banded Crake

This race, now listed by Ripley in his SYNOPSIS as *R. e. amauroptera* (Jerdon), only turned up once and that was in a small, wet area just west of Hitaura in the Rapti Dun in June.

**Vanellus cinereus** (Blyth). Greyheaded Lapwing

A fall and winter visitor to Kathmandu Valley, this fairly uncommon species at times were with redwattled lapwings. One we last collected was solitary, on a sand bank along the Rapti River.

**Calidris subminutus** (Middendorff). Longtoed Stint

Listed for areas east of Nepal in the SYNOPSIS, two or three were with many Temminck's stints on their northern migration along the Bagmati River, Kathmandu Valley in May.

**Larus argentatus** ssp. Herring Gull

Ripley has named the coastal areas of India and China as the range of herring gulls but to find a pair in Kathmandu Valley was rather unusual. Reported in *Pavo*, March, 1965. (November)

**Columba palumbus casiotis** (Bonaparte). Wood Pigeon

Only once have we come across the wood pigeon and that time a large flock was eating food in a heavily wooded area on the southern rim of Kathmandu Valley at 7400 feet. (February)

**Streptopelia orientalis orientalis** (Latham). Northern Rufous Turtle Dove

A bird of Tibet, Sikkim and Bhutan. A pair occupied a little grove at Kapan in Kathmandu Valley along with several *S. o. meena*. (October)

**Streptopelia tranquebarica tranquebarica** (Hermann). Red Turtle Dove

Biswas pointed out that this race had not been collected from far western Nepal, so we made it a point to secure them from the south-western *terai*. As Biswas and others surmised, these represent the western race extending into Baluchistan. (March)

**Tyto capensis longimembris** (Jerdon). Grass Owl

Although within the wide range of this owl, it had never been reported from Nepal before. Our specimen was only a few weeks old, brought in by Tharus to make medicine. We were in the Rapti Dun in November and the men said they had come across the river from the Nawalpur District.

**Otus scops sunia** (Hodgson). Scops Owl

For ten years we had been hearing a whistle at night—dash dot dash —throughout the Nepal *terai* and foothills. It was not until we collected a little red owl at the foot of the hills in Jhapa District did we identify the species. It was well after dark before it would tune up, but this particular one began half an hour *before* nightfall and R. L. Fleming, Jr. got it. (February)

**Otus bakkamoena gangeticus** Ticehurst. North Indian Collared Scops Owl

The only time we have found this race was when we put up a mist net across a dry ravine and beat the bushes along the banks. The place was in the far eastern *terai* in winter.

**Caprimulgus asiaticus asiaticus** Latham. Indian Nightjar

It is not often that when his plane is delayed, one can get a new bird record for the country. The call of this nightjar was so different and so persistent that the task was an easy one. What an ideal birthday present ! (March 22nd)

**Megalaima virens marshallorum** Swinhoe. Great Himalayan Barbet

Our west-central birds were *magnifica*, but those in far western Nepal are of this race. (October)

**Megalaima australis cyanotis** (Blyth). Blue-eared Barbet

Here was an example of another of those bird calls we had heard several years before but had remained a puzzle. Ripley included Sikkim

in its range so it was not surprising to find it in the far eastern *terai*. It was in forested areas at the base of the hills, usually practically invisible at the top of tall trees. (February)

**Indicator xanthonotus xanthonotus** Blyth. Honeyguide

It was Dr. Herbert Friedmann who alerted us to expect this species in Nepal. We located it on cliffs as indicated in Chinese literature several hundred years ago. The place was above Bigu near the Tibetan frontier in East No. 2. A second area was along the Kali Gandak River in Baglung District above Dana. In far north-western Nepal one would expect to find the western race of honeyguide. (November ; December)

**Picus squamatus squamatus** Vigors. Scalybellied Green Woodpecker

Evidently data gathered by Polunin, Lowndes and Proud of this fairly common species, were all from sight records. We collected it on the Gandak-Kosi watershed ridge at 10,000 feet in May.

**Picus canus sanguiniceps** Baker. Blacknaped Green Woodpecker

Specimens we first found in west-central Nepal were designated as *sanguiniceps*$\gtrless$*gyldenstolpei*. Later those taken in far western Nepal were the western race. (October)

**Dendrocopos himalayensis himalayensis** (Jardine and Selby). Himalayan Pied Woodpecker

We came across this species in lower Doti District in 1951 but did not collect it until we returned to Doti District eight years later. It was not at all common as it is farther west around Mussoorie, U.P., India. (October)

**Dendrocopos canicapillus semicoronatus** (Malherbe). Eastern Nepal Pygmy Woodpecker

Darjeeling and Sikkim, the western limit of this race of woodpecker, should now be extended to include far eastern Nepal. In the forested areas of Jhapa District it is a common bird. (January)

**Chrysocolaptes festivus festivus** (Boddaert). Blackbacked Woodpecker

Ripley records this species as far north as Dehra Dun, U.P. and east to Bihar and West Bengal. Our specimens were taken in the far western *terai* about half way between Dehra Dun and Bihar. It is another record in Nepal. (March)

**Alauda arvensis dulcivox** Brooks. Skylark

This large, western skylark in the SYNOPSIS is listed as no nearer than Kashmir or western U.P. R. L. Fleming, Jr., took one out of a flock

of some twenty-five south of the Gosainkund Lekh, Central Nepal, in December. We have also found three other races of *A. gulgula*, wintering in Nepal. They never sing here, only utter a repeated ' chirp.'

**Alauda gulgula gulgula** Franklin. Indian Skylark

Our early specimens collected before 1957 were not identified as to race. Subsequently, these and further specimens include this nominate race as well as *lhamarum* and *inopinata*. (November, February, March)

**Hirundo daurica japonica** Temminck & Schlegel. Japanese Striated Swallow

The Swallows, like skylarks, are great wanderers. Ripley places West Bengal in its winter range. Our specimen was from the Rapti Dun, Central Nepal, in January.

**Delichon urbica urbica** (Linnaeus). House Martin

Here is another species rather far from its usual range. The SYNOPSIS cites its range as western India in winter. Our bird was taken in the foothills of far western Nepal, in company with hundreds of other martins, most of which we believed to have been *D. n. nipalensis*. (April)

**Lanius cristatus cristatus** Linnaeus. Brown Shrik

Biswas omitted this species from his list. It has been collected throughout the *terai* in winter. An occasional bird in Kathmandu Valley in the cold season.

**Corvus macrorhynchos levaillanti** Lesson. Jungle Crow

As Biswas indicated in his list, No. 772, because of lack of material he could not identify *terai* races of *C. macrorhynchos*. From specimens we gathered in the far eastern *terai*, Traylor has assigned them to the above race. It was a common bird, gathering around our camp and neighbouring houses. (January)

**Corvus macrorhynchos culminatus** Sykes. Jungle Crow

Traylor has assigned specimens from the south-western *terai*, to this race on the basis, again, of bill measurements. Also, the base of the feathers of *terai* jungle crows is grey, not white like *C. m. intermedius* of the foothills and higher elevations. (March)

**Dendrocitta formosae occidentalis** Ticehurst. Himalayan Tree Pie

Our far western Nepal birds proved to be the western race of tree pie with the larger wing. Baitidi is not a great distance east of Almora, the eastern limit cited by Ripley, therefore not an unexpected addition to the Nepal list. (October)

**Bombycilla garrulus** ssp. ? (Linnaeus). The Waxwing

When R. L. Fleming, Jr., returned from the Kosi-Gandak watershed ridge with two waxwings (December, 1967), this was a most unusual find. The SYNOPSIS lists it as a rare straggler in Baluchistan and West Pakistan based on Stuart Baker's account of specimens obtained in Bannu and Kohat in 1906 and 1907. These two females (out of a flock of four) have no chestnut on the crest ; the back is an earthy brown ; the breast is earthy grey, paler grey on the abdomen and greyish white on the inner flanks. Wing 114-116. There are no known races. To complete the identification, comparative material is necessary.

**Irena puella sikkimensis** Whistler & Kinnear. Eastern Fairy Bluebird

Having seen the fairy bluebird in Assam and its being recorded in the SYNOPSIS from Sikkim, we were on the lookout for this species. Twice when we thought we had found it in Nepal, it turned out to be the sunny sheen on the Hair-crested Drongo, *Dicrurus h. hottentottus* (Linnaeus). However, we located the bluebird in Jhapa District in the lower foothills a little west of the Mechi River. (February)

**Spelaeornis longicaudatus** (Horsfield & Moore) Longtailed Wren-Babbler

The specimen we collected in far eastern Nepal looked like a small scaly-breasted wren-babbler with a combination on the breast of both light and dark colour phases. Not on our list for Nepal, we were pleased to add this rather inconspicuous species to our number. (March)

**Garrulax rufogularis occidentalis** (Hartert). Kashmir Rufouschinned Laughing Thrush

We saw only a single pair of this western race of laughing thrush. It was only a few miles from the Kumaon border. (October)

**Pteruthius xanthochloris occidentalis** Harington. Green Shrike-Babbler

Ripley gives the extreme eastern range of this race in Naini Tal. We collected this western race in Doti District. It was the only one we saw. (October)

**Minla strigula simlaensis** (Meinertzhagen). Stripethroated Siva

There are numerous records of the siva taken from central-west eastward. When we compared our birds taken in far western Nepal, they proved to be the western race. (April)

**Heterophasia capistrata capistrata** (Vigors). Blackcapped Sibia

We found both eastern and western races of sibia in Nepal. *H. c. nigriceps* (Hodgson) extends from western to central eastern Nepal,

with *H. c. bayleyi* in eastern Nepal. The western race was formerly called *H. c. pallida* Hartert. (April)

**Muscicapa superciliaris superciliaris** Jerdon. Whitebrowed Blue Flycatcher

A common flycatcher, we noted that all we examined had the well-defined supercilium in contrast to the eastern race in which it is slight or lacking. (March, April)

**Cettia fortipes pallidus** (Brooks). Western Strongfooted Bush Warbler

Only a single bird showed itself during our travel in far western Nepal. Its rather loud call disclosed its presence in a thicket along a stream. (April)

**Bradypterus tacsanowskius tacsanowskius** (Swinhoe). Chinese Bush Warbler

A rather rare bird, it was not reported closer than Bhutan. It is one of the occupants of extensive reed beds in northern Jhapa District where it is difficult to see. We found only one. (February)

**Acrocephalus agricola brevipennis** (Severtzov). Paddyfield Warbler

Biswas omitted this species from his list although also collected by both Hodgson and Koelz. Ours was from Jhapa District in February.

**Acrocephalus concinens** (Swinhoe). Bluntwinged Paddyfield Warbler

Another species collected a long way from its usual range. One race is in the Kashmir area with another in Assam and a third from China. Revisiting the reed beds of northern Jhapa District with mist nets we were able to collect this bird for the first time in Nepal. (February)

No. 597 on the list is now *Seicercus xanthoschistos jerdoni* (Brooks) rather than *S. x. xanthoschistos*.

**Phylloscopus tytleri** Brooks. Tytler's Leaf Warbler

Good fortune was with us when a warbler we took from a group in an oak tree in Dandeldhura District, West Nepal, was one whose eastern range is Uttar Pradesh. It is certainly uncommon in Nepal. (April)

**Phylloscopus fuscatus weigoldi** Stresemann. Dusky Leaf Warbler

Dr. Weigold, a grand old man in his 80's, may be glad to know that the race of dusky warbler named after him has been found in Nepal. The SYNOPSIS indicates that it extends to southern Tibet and Bhutan. We netted it in the reeds of northern Jhapa District in February.

**Phylloscopus cantator cantator** (Tickell). Blackbrowed Leaf Warbler

Our specimen, secured by R. L. Fleming, Jr., was one of a fairly large group of small birds in the foothill forests. It had previously been recorded beyond the eastern border of Nepal. *P. c. cantator* is the nineteenth leaf warbler we have taken in this country. (February)

**Turdus ruficollis ruficollis** Pallas. Redthroated Thrush

Listed from Bhutan and Assam, this eastern race occasionally visits Nepal. Mrs. Proud had seen them. One was hopping in a shady lane in Pokhara Town, West Nepal, in spring. There were several in the party from which we took two in East No. 2, at 11,000 feet in November.

**Parus melanolophus** Vigors. Crested Black Tit

Listed by the SYNOPSIS for Kumaon this species is another one would expect to find in far western Nepal. It was not common as it is in the north-western Himalayas. (October)

**Aegithalos concinnus iredalei** (Baker). Western Redheaded Tit

The race for most of Nepal listed by Biswas, No. 657, except those of the far west, should now be *A. c. rubricapillus* Ticehurst. Our birds with the larger wing are those of the western race which we collected in Baitidi District. (October)

**Anthus spinoletta** (Linnaeus). Water Pipit

Races of this species have been recorded from Uttar Pradesh and Sikkim. Our bird was in dry fields in the western end of Pokhara Valley in December.

**Arachnothera longirostris longirostris** (Latham). Little Spiderhunter

The SYNOPSIS places this species as near to Nepal as Assam and East Pakistan. It is fairly common along the base of the hills and the Mechi River in far south-eastern Nepal, in groves and forested areas in the vicinity of *Loranthus* and wild banana trees. (February)

**Ploceus philippinus burmanicus** Ticehurst. Eastern Baya

Recorded from eastern Bihar, this race is quite common in the eastern *terai*. We usually found them in grassy areas around villages. (January, February)

**Lonchura malacca atricapilla** (Vieillot). Blackheaded Munia

Biswas lists the western race from central Nepal. We add the eastern race, taken in Jhapa Town. These were in a large flock of both blackheaded and spotted munias. (February)

**Carpodacus rubicilla severtzovi** Sharpe. Great Rosefinch

As reported in *Pavo*, March, 1965, we acquired a specimen of this species through Mr. G. B. Gurung, a member of the Diesselhorst team which collected in 1962. Ripley records the bird as near as Gyantse. We now know it also reaches Khumbu, south of Mt. Everest. (August)

**Emberiza fucata fucata** Pallas. Greyheaded Bunting

Ripley did not include this race in his SYNOPSIS though it has been reported by Vaurie from Bengal. Here is another bird we netted in reed beds near the Mechi River in Jhapa District. (January)

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# The Sciaenidae of the coastal waters of Visakhapatnam

BY

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(*With a plate*)

Thirteen species of the family Sciaenidae, popularly known as drums, grunters, croakers or jew fish, are caught practically throughout the year in the coastal waters of Visakhapatnam, where they constitute a minor but valuable fishery by indigenous craft and gear. Most of the catches, mainly by boat seine, are of small to medium-sized specimens.

One of the earliest Indian records of sciaenids is from Visakhapatnam by Russell (1803), who described 6 species. Blyth (1860) recorded 9 species and Day (1878) described 27 species from India. Lloyd (1907) described 5 species of *Sciaena* and 1 of *Otolithus*. Chaudhuri (1923) recorded *Sciaena coibor* and *Umbrina indica* from Chilka Lake. Pillay (1929) reported 3 genera and 7 species from Travancore. Fowler (1933) recognised 8 genera under Sciaenidae and described 53 species from India. Jacob (1948) reported 7 species of Sciaenidae from west coast of the old Madras State. Munro (1955) described 17 species from Ceylon. Seshappa (1956) recorded *Johnius hololepidotus* for the first time from Indian waters.

## MATERIAL AND METHODS

The material for the present work was collected in the fishing villages of Visakhapatnam, from catches in coastal waters by boat seine and gill net. The linear measurements are based on specimens preserved in 5% formalin. The body proportions and length of air bladder described for the various species in the text, are given as percentage of standard length. The size range of the specimens examined refers to the standard length.

## OBSERVATIONS

The sciaenids are characterised by a fairly elongate body, covered with cycloid and/or ctenoid scales, with a spinous dorsal consisting of ten spines and a soft dorsal having a feeble spine and a varying number of

rays ; the two dorsals are not completely separated. Anal fin of two spines (first spine short) and 7 rays much shorter than soft dorsal. Caudal truncate, emarginate or pointed but never forked. Jaws equal or sub-equal. Air bladder present, physoclistous.

Thirteen species of sciaenids belonging to five genera are described from the coastal waters of Visakhapatnam, in the western part of the Bay of Bengal.

### KEY TO GENERA

1a. Solid barbel on chin.......................................*Dendrophysa*

1b. No barbel on chin
  2a. Caniniform teeth present ; caudal pointed
    3a. Lower jaw prominent, no pores on chin................*Otolithes*
    3b. Lower jaw shorter than upper, chin with pores........*Otolithoides*
  2b. No caniniform teeth ; chin with pores
    4a. Soft dorsal and anal covered with small scales............*Johnius*
    4b. Soft dorsal and anal naked, only bases covered with scales.................................*Nibea*

## Genus JOHNIUS Bloch

Bloch, 1739, Naturges. Ausländ. Fische, 7 : 132. Type *J. carutta* Bl.

Bleeker (1863) split the genus into *Johnius* and *Pseudosciaena*, the latter distinguished by an inner row of enlarged teeth on the lower jaw, absent in the former. According to Weber & De Beaufort (1936), *Pseudosciaena* has also terminal mouth and oblique cleft whereas *Johnius* has inferior mouth and horizontal cleft. However, Fowler (1933) and Munro (1955) have treated *Pseudosciaena* Bleeker as a synonym of *Johnius* Bloch.

*General characters*

Lower jaw equal to or slightly shorter than upper. Chin usually with conspicuous pores, no barbel under symphysis. Gill rakers short. No caniniform teeth. Spinous dorsal with ten spines and soft dorsal with one spine and 23-31 rays and anal fin with two spines and 7 rays. Pectoral rays 14-20. Of the 13 species of sciaenids from the coastal waters of Visakhapatnam 5 belong to genus *Johnius*.

### KEY TO THE SPECIES OF *Johnius*

1a. Lateral line broad and conspicuous.............................*carutta*

1b. Lateral line narrow
  2a. Six dark brown vertical bands. Carrot-shaped air bladder with 16-18 caecae ......................................*aneus*

2b. No bands.

3a. Air bladder hammer-shaped with caecae. No dark spot on pectoral axilla.

4a. Depth 31·57-33·34. Air bladder with 13-14 caecae.............................................................*dussumierii*

4b. Depth 32·32-33·80. Air bladder with 14-15 caecae.............................................................*belengerii*

3b. Air bladder carrot-shaped. No caecae; instead 2 horn-like projections anterolaterally; A dark spot on pectoral axilla.........................................*axillaris*

## 1. **Johnius carutta** Bloch

*Johnius carutta* Bloch, 1793. Naturgesch Ausländ. Fische. 7 : 133, pl. 356 (Type locality : Tranquebar).

*Diagnosis :* D. X+I 26-29, A. II 7, P. 14-17, V. I 5, Vert. 25.

Depth 28·89 to 29·72 ; head 32·00 to 33·54 ; snout 9·80 to 10·00 ; eye 7·81 to 9·80. Upper jaw overlaps lower. 5 pores on chin. A row of pores across snout. Lateral line broad and conspicuous and curves gradually to below end of anal fin behind which it runs straight. G.R. 3-5+7-10. Scales on head, cheeks and suborbitals cycloid and on body ctenoid.

*Colour :* Purplish brown above, light brown below. First dorsal dark, other fins with grey edges.

*Air bladder* (Plate, 1) : The air bladder of *J. carutta* is hammer-shaped, having 14-15 caecal outgrowths with very small branches except the last two caecae which are undivided. The number of caecae is not equal on both sides ; in the 122 air bladders examined there was a difference of $\pm 1$ on one side. Last caecum extends behind pointed posterior end of air bladder. Length of air bladder 37·48 to 44·87.

The size of the 158 specimens examined ranged between 54·7 mm. and 175·0 mm.

## 2. **Johnius aneus** Bloch

*Johnius aneus* Bloch, 1793, Naturgesch Ausländ. Fische. pt. 7 : 135, pl. 257 (Type locality : Malabar).

*Diagnosis :* D. X+I 23-25, A. II 7, P. 15-17, V. I 5, Vert. 25.

Depth 33·08 to 34·76 ; head 35·56 to 37·36 ; snout 7·96 to 8·35 ; eye 8·42 to 8·98. Upper jaw overlaps lower. Chin with 5 pores. Operculum with 2 spines. Anal originates below 12th to 14th dorsal ray. G.R. 4-7+9-14. Scales on head, preopercle and cheek cycloid, on body ctenoid. Pectorals about as long as head without snout.

*Colour :* There are 6 dark brown vertical lines on the sides of the body, of which 2nd and 3rd extend below lateral line.

*Air bladder* (Plate, 2) : Day (1878) described the air bladder of *J. aneus* as an oval structure having about 30 lateral processes, but the present study, based on the examination of 80 specimens, shows that the number of caecae is only 16-18. The anterior caecae are shorter than in the other species of *Johnius* but posteriorly the caecae are elongated and the last 2 to 4 caecae are much longer than the rest. The pointed posterior end of air bladder extends beyond last caecum. Length of air bladder 37.18 to 45·45.

The 93 specimens examined ranged between 25·7 mm. and 187·0 mm.

### 3. **Johnius dussumierii** (Cuv. & Val.)

*Corvina dussumieri* Cuvier & Valenciennes, 1830. Hist. Nat. Poiss. **5**: 119 (Type locality : Malabar).

*Diagnosis :* D. X+I 26-30, A. II 7, P. 15-18, V. I 5, Vert. 25.

Depth 31·57 to 33·34 ; head 31·20 to 33·11 ; snout 7·14 to 7·32 ; eye 8·19 to 8·87. Lower jaw shorter ; 5 pores on chin ; opercle with two flat weak spines, preopercle with two or three small spines. Scales cycloid on head and operculum, ctenoid on body. Lateral line slightly arched to below middle of soft dorsal. Origin of anal below middle of soft dorsal. Caudal rounded. First ventral ray filamentous and prolonged. G.R. 4-7+10-14.

*Colour :* Dark brown above, lighter on sides ; ventral side whitish. Spinous dorsal black ; soft dorsal and caudal grey.

*Air bladder* (Plate, 3) : Glistening white. Anterior side bulges laterally into rounded prominence. Caecae 13 to 14, last caecum undivided, does not extend behind pointed posterior end of air bladder which extends a short distance behind vent. Length of air bladder 37·15 to 37·18.

A total of 107 specimens between 44·1 mm. and 141·0 mm. were examined. Occurs practically throughout the year.

### 4. **Johnius belengerii** (Cuv. & Val.)

*Corvina belengerii* Cuvier & Valenciennes, 1830. Hist. Nat. Poiss. **5** : 120. (Type locality : Malabar).

*Diagnosis :* D. X+I 28-29, A. II 7, P. 17, V. I 5, Vert. 25.

Depth 32·32 to 33·80 ; head 31·62 to 34·56 ; snout 7·86 to 7·95 ; eye 8·20 to 8·86. Free border of snout deeply quadrilobate. Chin with 5 pores. G.R. 3-7+9, short. Scales ctenoid except on snout and below

eye where they are cycloid. Origin of anal below 12th dorsal ray. Length of pectoral equals head length excluding snout. First ventral ray with filamentous prolongation. A blotch on operculum.

*Colour :* Brown above, white below. Spinous dorsal, anal and ventrals with dark edge. Pectorals pale yellow.

*Air bladder* (Plate, 4) : Shape of air bladder more or less similar to that of *J. carutta* and *J. dussumierii* but number of caecae 14 to 15. Length of air bladder 38·62 to 39·36.

Rare. Only 2 specimens were obtained in June, measuring 56 mm. and 102 mm.

### 5. **Johnius axillaris** (Cuv. & Val.)

*Corvina axillaris* Cuvier & Valenciennes, 1830, Hist. Nat. Poiss. 5 : 113 (Type locality : Malabar).

*Diagnosis :* D. X+I 25-29, A. II 7, P. 15-18, V. I 5, Vert. 24.

Depth 34·69 to 35·92, head 32·97 to 38·00 ; snout 7·91 to 7·92 ; eye 7·91 to 8·42. Lower jaw slightly shorter than upper. A median pore below mandibular symphysis and two slit-like pores on each side of it. Scales on head and opercle cycloid and on body ctenoid. G.R. 9-12+ 19-23.

*Colour :* Brownish-grey above, white on ventral side. A black axillary spot which extends considerably above base of pectoral. Upper two-thirds of spinous dorsal, black and first half of soft dorsal, dark.

*Air bladder* (Plate, 5) : The air bladder of *J. axillaris* has the most glistening colour. The anterior rectangular part tapers gradually to posterior end which is pointed. Caecae absent, instead, anterolaterally arise two unbranched horn-like processes directed forward. The entire surface of the air bladder is covered by a thin layer of white fatty substance, whereas in the air bladder of other sciaenids, where caecae are present, only the caecae are covered with this fatty substance. Length of air bladder 33·34 to 51·63.

A total of 445 specimens between 20·5 mm. and 135·0 mm. were examined. Juveniles between 20 mm. to 30 mm. occur in large numbers from March to May.

*Note :* This species possesses all the characters of genus *Johnius* Bloch, 1793 defined by Trewavas (1964 : 110) except that it lacks the paired series of arborescent appendages on the air bladder (*vide* Discussion).

## Genus Nibea Jordan & Thompson

Jordan & Thompson, 1911, Proc. U.S. Nat. Mus. 39 : 244, 246. Type *Pseudotolithus mitsukurii* Jordan & Snyder.

Snout prominent, with four pores at tip arranged in a transverse row of three above a median pore. Chin with five conspicuous pores. No barbel. Preopercle edge serrated or crenulate. Scales on body ctenoid. Can be distinguished from *Johnius* in that only the bases of soft dorsal and anal are covered by scales.

### Key to the species of *Nibea*

1a. Five broad black oblique bands on body with two longitudinal rows of black spots on dorsal side.................................*maculata*

1b. No bands or spots.

- 2a. Depth 33·02-37·23. Dark spot behind each dorsal spine and ray forming black line along dorsal fin. Air bladder carrot-shaped with 17-20 caecae.................................*soldado*
- 2b. Depth 31·43-31·78. No dark spot behind dorsal spine. Air bladder hammer-shaped with 16-17 caecae.......................*sina*

### 1. **Nibea maculata** (Bloch & Schneider)

*Johnius maculatus* Bloch & Schneider 1801. Syst. Ichth. : 75.

*Diagnosis :* D. X+I 22-24, A. II 7, P. 16-18, V. I 5, Vert. 25.

Depth 30·46 to 32·08 ; head 31·34 to 32·66 ; snout 8·06 to 8·52 ; eye 8·60 to 8·71. Lower jaw shorter than upper. Transverse row of 4 pores across snout, 1 below mandibular symphysis and 2 more on either side. G.R. 4-5+7-9.

*Colour :* An important diagnostic character is the presence of 5 interrupted broad black bands running vertically : the first arising on the nape passes backward and downward and terminates abruptly after crossing lateral line ; the second, commencing opposite fifth to seventh dorsal spines, passes obliquely downward and terminates above middle of ventral fin ; the third arising below second and third dorsal rays or between the two dorsal fins, runs parallel to second band ; the fourth band commences below centre of second dorsal and descends to the lateral line and the fifth runs parallel to it below last few dorsal rays. In addition, 2 rows of black spots run along the dorsal surface. Fins are grey with small irregular black spots.

*Air bladder* (Plate, 6) : The air bladder of *N. maculata* has a more glistening silvery colour than that of other species. The 16 or 17 caecae are close together, very short and much branched. The last caecum is also

branched. The air bladder suddenly tapers at the posterior end which is without caecae. Length of air bladder 36·48 to 37·25.

This is rather uncommon in the coastal waters of Visakhapatnam. Only five specimens between 58 mm. and 122 mm. were obtained.

### 2. **Nibea soldado** (Lacépède)

*Holocentrus soldado* Lacépède, 1802, Hist. Nat. Poiss. 4 : 344, 389. (Type locality : Cayenna, East Indies).

*Diagnosis :* D. X+I 23-26, A. II 7, P. 15-17, V. I 5, Vert. 25.

Depth 33·03 to 37·23 ; head 34·97 to 36·56 ; snout 9·60 to 10·05 ; eye 6·33 to 7·26. Jaws more or less equal. Preopercle distantly denticulate, opercle with two weak spines. Scales on head cycloid and on body ctenoid. Lateral line strongly arched to below middle of soft dorsal and straight above hind edge of anal. Origin of anal below 9th or 10th dorsal ray. G.R. 4-7+10-14.

*Colour :* Brownish-grey above, whitish below. Fins pale yellow. Spinous dorsal with dark margin, dark spot on membrane behind each dorsal spine and ray forming a black line along dorsal fin.

*Air bladder* (Plate, 7) : Caecae 17 to 20. Branches of caecae slender and long ; type of branching different from that of others ; last caecum undivided. In some specimens the number of caecae on both sides is equal, in others a difference of 1 is noted. Length of air bladder 34·18 to 43·93.

A total of 145 specimens between 32·5 mm. and 190·0 mm. were collected between October and June in small numbers.

### 3. **Nibea sina** (Cuv. & Val.)

*Corvina sina* Cuvier & Valenciennes, 1830, Hist. Nat. Poiss. 5 : 122. (Type locality : Pondicherry, Malabar).

*Diagnosis :* D. X+I 26-29, A. II 7, P. 15-19, V. I 5, Vert. 25.

Depth 31·43 to 31·78 ; head length 31·78 to 32·86 ; snout 8·18 to 8·67 ; eye 6·63 to 7·12. Jaws more or less equal. 4 big and 2 small pores on chin. Anal origin before middle of soft dorsal. Origin of spinous dorsal above that of pectoral. 3rd and 4th dorsal spines longest. Opercle with 2 flat spines and preopercle with 2 or 3 small spines. Scales on head and opercle cycloid and on body ctenoid. G.R. 5-7+11-15.

*Colour :* Brown above, silvery with gold reflections below. Spinous dorsal black, other fins grey. Ventrals white.

*Air bladder* (Plate, 8): Air bladder resembles that of *J. carutta*, *J. dussumierii* and *J. belengerii* but caecae 16 to 17. Anteriorly, air bladder is attached to depressions on 2nd, 3rd and 4th vertebrae. Length of air bladder 42·22 to 43·40.

Number of specimens examined 60, between 35 mm. and 190 mm.

### Genus Dendrophysa Trewavas, 1964

Type: *Umbrina russelli* Cuvier, 1830

This genus resembles *Johnius*, but can be distinguished by the presence of a solid barbel below chin. Lower jaw shorter than upper jaw. The genus was created by Trewavas (1964) to include three species of Indo-West Pacific sciaenids described by earlier workers under *Umbrina* or *Sciaena*. Two of them occur at Visakhapatnam.

#### Key to the species of *Dendrophysa*

1a. Barbel robust, equals half diameter of eye, scales on head and body cycloid, dorsal fin rays 23 to 26. Air bladder with 14-15 caecae. Posterior end of air bladder long and pointed .......... *dussumierii*

1b. Barbel small, scales on head cycloid and on body ctenoid. Dorsal fin rays 27 to 31. Air bladder with 11 caecae. Last caecum extends behind blunt posterior end of air bladder .......... *macroptera*

### 1. **Dendrophysa dussumierii** (Valenciennes)

*Umbrina dussumierii* Valenciennes, 1833, Hist. Nat. Poiss. 9: 481. (Type locality: Coromandel).

*Diagnosis:* D. X+I 23-26, A. II 7, P. 16-17, V. I 5, Vert. 25.

Depth 29·22 to 31·32; head 29·62 to 30·36; snout 8·32 to 8·68; eye 7·62 to 8·02. Upper jaw overlaps the lower; chin with 5 pores. A robust barbel equal to half eye diameter. Scales on head and body cycloid. 2nd, 3rd and 4th dorsal spines with filamentous prolongation, 2nd and 3rd the largest, almost as high as body, the 4th slightly shorter. G.R. 3-4+8-10.

*Colour:* Dark brown, with metallic reflections below. Spinous dorsal dark, other fins black except ventral which is yellow.

*Air bladder* (Plate, 9): Hammer-shaped with 14 to 15 caecae. The posterior part is long and pointed. Last one or two caecae on either side undivided. Length of air bladder 37·82 to 38·02.

A total of 22 specimens between 47·5 mm. and 163·0 mm. were examined.

### 2. **Dendrophysa macroptera** (Bleeker)

*Umbrina macropterus* Bleeker, 1863, Nat. Tijds. Nederland. Indie, 4 : 254. (Type locality : Priaman, Sumatra).

*Diagnosis :* D. X+I 27-31, A. II 7, P. 14-18, V. I 5, Vert. 25.

Depth 28·42 to 30·06 ; head 27·36 to 30·49 ; snout 8·89 to 10·30 ; eye 6·97 to 7·41. A symphysical barbel shorter than pupil with a barbel pore and with 2 conspicuous pores on either side of the median one. Scales on head, opercle and cheeks cycloid and on body ctenoid. G.R. 3-5+8-10.

*Colour :* Brown above, light brown below. A dark mark on opercle. Fins yellowish, dotted with brown.

*Air bladder* (Plate, 10) : Hammer-shaped with 11 caecae on either side. Third caecum is shorter and more branched than others ; it arises behind the anterior bulged part of bladder unlike in *Johnius carutta*, *J. dussumierii*, *J. belengerii*, *Nibea sina* and *Dendrophysa dussumierii* in which it arises on the posterior part of the bulged part. Last caecum is branched and extends behind body of air bladder. Length of air bladder 36·84 to 45·82.

48 specimens between 60 mm. and 190 mm. were examined.

## Genus Otolithoides Fowler

Fowler, 1933, Bull. U.S. Nat. Mus. 12 : 364. Type *Otolithus biauritus* Cantor.

Lower jaw slightly shorter than upper ; 6 pores on chin, 2 of them smaller than others. Teeth in narrow villiform bands in both jaws; in upper jaw, the outer row is constituted of 4 strong caniniform teeth, which are seen even when the mouth is closed. Only a single specimen of one species of *Otolithoides* : *O. brunneus* (Day) was observed in the catches.

### 1. **Otolithoides brunneus** (Day)

*Otolithus brunneus* Day, 1873, Journ. Linnean Soc. London, 11 : 524. (Type locality : Bombay).

*Diagnosis :* D. X+I 26, A. II 7, P. 18, V. I 5.

Depth 27·75 ; head 28·46 ; snout 7·32; eye 7·25. Body shape resembles that of *Otolithes argenteus* but lower jaw is shorter than upper. All the generic characters are present. Height of soft dorsal gradually increases to last ray. Caudal pointed. Anal origin below 8th dorsal ray. G.R. 5+9.

*Colour :* Brownish above, with gold reflections below.

*Air bladder* (Plate, 11) : Caecal outgrowths 25-26. Like width of air bladder, length of caecae also decreases gradually toward posterior end. Anteriorly air bladder is oval and caecae are longer than width of air bladder. Posterior end is bluntly pointed. Length of air bladder was 54 mm. in the specimen of 174 mm. standard length.

## Genus OTOLITHES Oken

Oken, 1817, Isis, p. 1782. Type *Johnius ruber* Bloch.

The genus is characterised by the presence of conical teeth in both jaws. Lower jaw prominent. Second dorsal fin long. Body more elongated than in *Johnius* and *Dendrophysa*. Caudal truncate or pointed.

Of the three species of *Otolithes* recorded from Indian waters, 2 species occur along Visakhapatnam coast, *O. ruber* and *O. argenteus.*

### KEY TO THE SPECIES OF *Otolithes*

1a. G.R. 8+16, Anal origin below 16th dorsal ray, air bladder with 25-26 much branched caecae.......................................*ruber*

1b. G.R. 4-7+9-12, Anal origin below 12th dorsal ray, air bladder with 30-35 caecae..........................................*argenteus*

### 1. **Otolithes ruber** (Schneider)

*Johnius ruber* Schneider, 1801, Syst. Ichth. : 75, pl. 17. (Type locality : Tranquebar).

*Diagnosis :* D. X+I 28, A. II 7, P. 17, V. I 5.

Depth 29·68 ; head 28·96 ; snout 8·42 ; eye 6·26. The caniniform teeth, so characteristic of the genus were missing perhaps because of struggle in the boat seine in which it was caught. Lateral line curves to above middle of anal. Anal origin below 16th dorsal ray. G.R. 8+16.

*Colour :* Light brown. Spinous dorsal with black edge, soft dorsal and anal with grey edges. Other fins yellow.

*Air bladder* (Plate, 12, 12A and 12B). Day (1878) described the air bladder of *O. ruber* as having 34 lateral processes ; the single specimen examined had only 25 caecae on one side and 26 on the other. Each caecum is divided into 3 branches of which the main branch extends perpendicularly to the lateral margin of the air bladder. From this main branch are given off one dorsal and one ventral branch. Standard length was 148 mm. and length of air bladder 71 mm.

Rare. The single specimen collected in May measured 148 mm.

## 2. **Otolithes argenteus** Cuv. & Val.

*Otolithes argenteus* Cuvier & Valenciennes, 1830, Hist. Nat. Poiss., 5 : 62. (Type locality : Batavia, Malabar, Malacca).

*Diagnosis :* D. X+I 27-31, A. II 7, P. 14-16, V. I 5, Vert. 25.

Depth 23·14 to 28·34 ; head 30·79 to 31·98 ; snout 6·76 to 8·37 ; eye 5·23 to 7·43. Lower jaw prominent. Operculum with 2 spines. No pores either on snout or on chin. Teeth in upper jaw in villiform band ; anteriorly one or two strong, curved long caniniform teeth, the outer the largest. In mandible on each side, a strong curved symphysical caniniform tooth placed between the 2 upper ones. Second anal spine weak. Dark blotch on opercle. G.R. 4-7+9-12.

*Colour :* Brown with silvery reflections, darker along back. Edge of dorsal dusky ; other fins yellowish.

*Air bladder* (Plate, 13, 13A, 13B and 13C): Anterior part of air bladder is oval ; caecae 30 to 35. The number of caecae on the two sides may be equal or there may be a difference of ± 1 on one side. The caecae are arranged close together with little space between. Each caecum is much branched and one cluster of branches of each caecum is folded on to the dorsal side of the air bladder. The branching of the caecae increases with growth. Length of air bladder 35·22 to 49·02.

84 specimens between 44·1 mm. and 255·0 mm. were examined.

TABLE I

MERISTIC DATA OF SCIAENIDS

| Species | Dorsal | Pectoral | Gill rakers | Vertebrae |
|---|---|---|---|---|
| *Johnius carutta* .. | X+I 26-29 | 14-17 | 3-5+7-10 | 25 |
| *J. aneus* .. | X+I 23-25 | 15-17 | 4-7+9-14 | 25 |
| *J. dussumierii* .. | X+I 26-30 | 15-18 | 4-7+10-14 | 25 |
| *J. belengerii* .. | X+I 28-29 | 17 | 3-7+9 short | 25 |
| *J. axillaris* .. | X+I 25-29 | 15-18 | 9-12+19-23 | 24 |
| *Nibea maculata* .. | X+I 22-24 | 16-18 | 4-5+7-9 | 25 |
| *N. soldado* .. | X+I 23-26 | 15-17 | 4-7+10-14 | 25 |
| *N. sina* .. | X+I 26-29 | 15-19 | 5-7+11-15 | 25 |
| *Dendrophysa dussumierii* .. | X+I 23-26 | 16-17 | 3-4+8-10 | 25 |
| *D. macroptera* .. | X+I 27-31 | 14-18 | 3-5+8-10 | 25 |
| *Otolithoides brunneus* .. | X+I 26 | 18 | 5+9 | — |
| *Otolithes ruber* .. | X+I 28 | 17 | 8+16 | — |
| *O. argenteus* .. | X+I 27-31 | 14-16 | 4-7+9-12 | 25 |

*Note.*—The number of spines and rays in anal and ventral fins is constant in all the species and specimens examined : II 7, and I 5 respectively.

## Discussion

*Structure of Air Bladder and its relevancy to phylogeny and classification :*

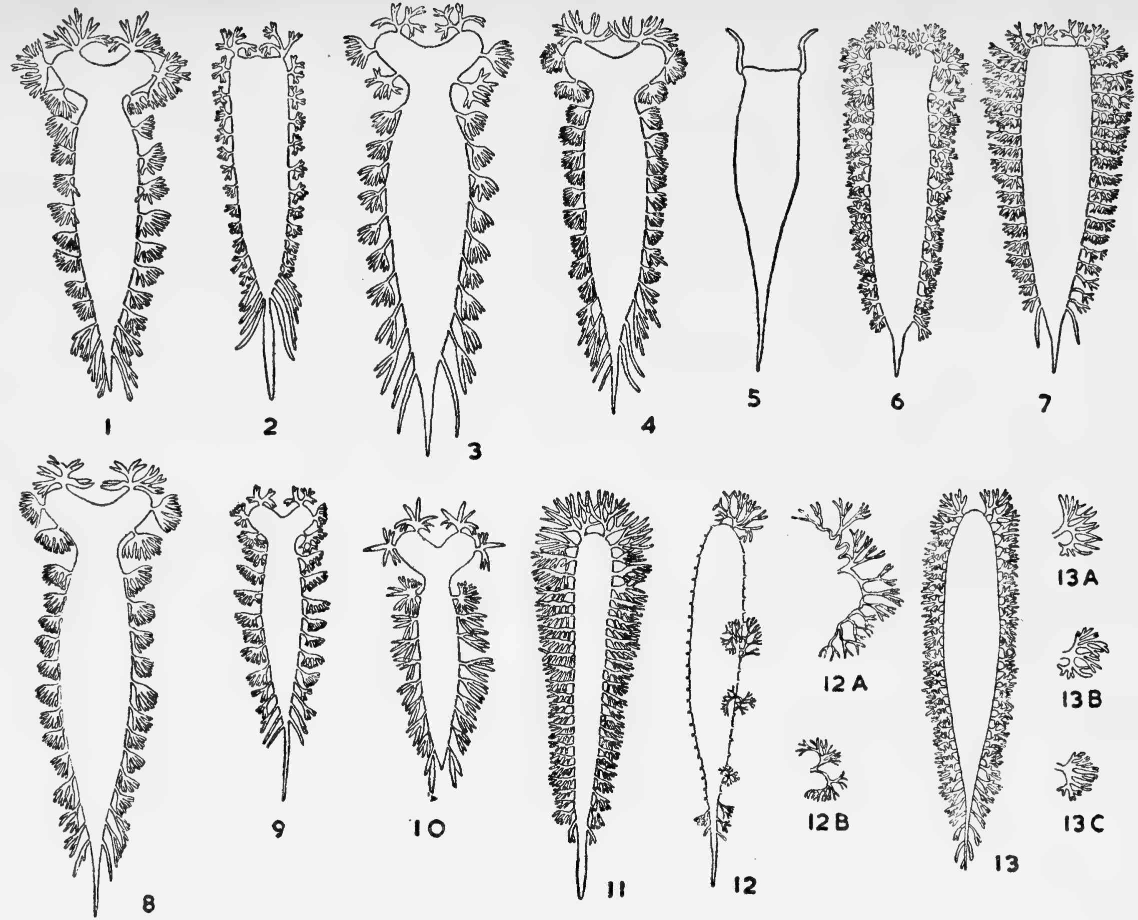
Trewavas (1962, 1964) has stated that the primary divisions of the family Sciaenidae may be based on the ground plan of the air bladder where this is complex, ' complex ' to mean such species in which the air bladder has arborescent appendages.

Our studies on thirteen Indo-West Pacific sciaenids which occur at Visakhapatnam on the east coast of India (western part of Bay of Bengal) indicate the need for circumspection in accepting entirely Trewavas' grouping of sciaenid species on the basis of the structure of the air bladder and its relevance to phylogeny and classification :

1. Six species of three different genera—three species of *Johnius : dussumierii* (Cuvier), *belengerii* (Cuvier) and *carutta* Bloch, one of *Nibea* : *sina* (Cuvier), and two of *Dendrophysa* : *macroptera* (Blkr.) and *dussumierii* (Val.) possess hammer-shaped air bladders with arborescent appendages (Tribe Otolithini). If Trewavas' principle were to be strictly applied, then on the basis of similarity of air bladder, *N. sina* (and the two species of *Dendrophysa*) would have to be considered closer to the above three species of *Johnius* than to the other two species of *Nibea* (*vide* 2 below) ; the above three species of *Johnius* would be closer to *N. sina* and the above two species of *Dendrophysa* than to *J. aneus* Bloch.

2. Six other species of four genera : one of *Johnius* : *aneus* Bloch, two species of *Nibea* : *maculata* (Schn.) and *soldado* (Lac.), one of *Otolithoides* : *brunneus* (Day) and two species of *Otolithes* : *ruber* (Schn.) and *argenteus* Cuvier have carrot-shaped air bladders with arborescent appendages. Again, if Trewavas principle were to be applied, these two species of *Nibea* (as also *Otolithoides brunneus* and the two species of *Otolithes*) would have to be considered closer to *J. aneus* than to *N. sina*. *J. aneus* would be closer to the above species than to the other three species of *Johnius* (*vide supra*).

3. *Johnius axillaris* (Cuvier), 1830 possesses all the characters of genus *Johnius* as defined by Trewavas (1964 : 110) except that the air bladder lacks arborescent appendages. Since she states that her definition of *Johnius* ' excludes species with gas bladders of a different pattern ' i.e. species with air bladder lacking arborescent appendages, we would have to remove *J. axillaris* from the genus and from tribe Otolithini and place it in tribe Sciaenini or perhaps with genus *Larimus* because the simple air bladder of *J. axillaris* bears two (horn-like) outgrowths anterolaterally as in *Larimus* (*vide* Trewavas, 1962: 168, fig. 1A). But probably Trewavas no longer recognises her tribe Otolithini (which she created to include *Johnius, Otolithes, Argyrosomus, Dendrophysa*




General structure of the air bladder in the Sciaenidae spp.

1. *Johnius carutta*; 2. *J. aneus*; 3. *J. dussumierii*; 4. *J. belengerii*; 5. *J. axillaris*; 6. *Nibea maculata*; 7. *N. soldado*; 8. *N. sina*; 9. *Dendrophysa dussumierii*; 10. *D. macroptera*; 11. *Otolithoides brunneus*; 12. *Otolithes ruber*; 12A. One of the middle caecal outgrowths of *O. ruber*; 12B. One of the posterior caecal outgrowths of *O. ruber*; 13. *O. argenteus*; 13A. One of the anterior caecal outgrowths of *O. argenteus*; 13B. One of the middle caecal outgrowths of *O. argenteus*; 13C. One of the posterior caecal outgrowths of *O. argenteus*.

and other genera having air bladders with arborescent appendages) because Trewavas and Yazdani (1965) state that ' the large and diverse subfamily Otolithinae ' (p. 249) is the ' group ranked as a Tribe by Trewavas in 1962 ' (p. 249, footnote).

## Summary

Thirteen species of Sciaenids under five genera are recorded from coastal waters of Visakhapatnam. For the first time an attempt to distinguish the various species of Sciaenidae of Visakhapatnam coast on the basis of differences in the general structure of the air bladder has been made. Separate keys are given for various genera and species.

## Acknowledgement

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# Notes on the Thysanoptera collected during western and southern India Survey, 1962, with a Review of the Thysanoptera complex of the Hosts

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(*Communicated by Dr. B. Biswas*)

## Part I

### I. Introduction

The author, while surveying some hilly and forest tracts in Kerala, Madras, Maharashtra, and Mysore States as Liaison Officer to Dr. E. S. Ross of National Geographic Society & California Academy of Sciences' Entomological Expedition to Tropical Asia during February-April 1962, collected many species of insects in their natural state. The collections include a good number of Thysanoptera from several host plants, some of them new records to India and others collected on plants hitherto not recorded as hosts.

The majority of Thysanoptera are phytophagous and a few predatory. Most of them may be found on the surface feeding on the soft tissues of flowers, shoots, and leaves; others live in galls on the plant body produced by the reaction of the plant to the presence of the insect. According to Mani (1964) ' the thysanopterous galls are predominantly leaf galls but some remarkable bud galls and unique stem and flower galls are also known'. Though the insects are found inside the galls, in fact these insects remain external to the surface of the leaf and are gradually enclosed in a cavity by a folding movement of the leaf margin, which produces the fold galls or roll galls. Sometimes button-shaped pouch galls are also produced. The gallicolous forms may be either primary gall-formers or ' inquilines ' residing in the galls of other species of thrips or other insects. Another interesting feature of some of them is that, though they can stimulate the production of galls, they still behave as inquilines and stay in the galls of other species. Many species are stenophagous and are confined to a few related species of hosts with host pre-

ferences ; a few others have a wide latitude of hosts, i.e. they are polyphagous. The feeding may be confined to specific parts like leaves, petals, etc., or it may be non-specific and extend to different parts of the same plant or different parts on different hosts. Markkula's (1953) classification of hosts in the case of aphids is applicable to Thysanoptera. According to him the hosts may be true hosts (brutwirte), pseudohosts (scheinwirte), or non-hosts (nichtwirte). True hosts are those plants or parts of plants on which the species develop and reproduce attaining normal age. They may be primary, or secondary ; and permanent, or temporary (on which, during a period of host-suitability, e.g., during an outbreak or a seasonal peak on the permanent host, a sequence of two to three generations develop), or accidental hosts (on which rarely and sparsely one generation may develop). Pseudohosts are plants on which a few nymphs may be borne which, however, do not attain maturity. Non-hosts are plants on which no reproduction or development takes place, but on which the longevity of the insect may be extended by a few more days.

The habits and behaviour of phytophagous species is as important as their identification. The observations presented below may be useful for both pure taxonomists and applied workers. The literature on Thysanoptera is scattered and probably inaccessible for an applied entomologist and the changes that have been made in the nomenclature often confuse him. Hence, in addition to remarks and important synonymies under each species, a review has been given on the Thysanoptera complex of each host species recorded during the survey.

This paper has been arranged in two parts. Part I comprises the Introduction; Review of Literature; Localities of collections; List of species collected; List of their hosts and Notes on the species collected. Part II comprises the Thysanoptera complex of the host plants recorded during the present survey.

## II. Review of Literature

The earliest work on Indian Thysanoptera dates back to Newman (1856) who described the two species *Idolothrips halidayi* and *Phlaeothrips anacardi*, followed by one species by Kieffer (1908). We owe our knowledge on Indian Thysanoptera chiefly to Bagnall, Hood, Karny, Moulton, and Priesner, who described many new species from material sent to them for identification by Indian institutes or workers. Ramakrishna Ayyar (hereafter referred as Ramakrishna), the pioneer Indian worker, brought many species of Indian thrips to light, particularly of southern and western India. Later contributions were made by Margabandhu, Shumsher Singh, and Seshadri, either independently or along with other workers. Ananthakrishnan added much to our

knowledge since Ramakrishna, and published many papers including several on new genera and species. Stray papers have been published by Patel & Patel, Bhatti, Lakshminarayana *et al.*, Stannard & Ushakumari, etc. References on the earlier work on Indian Thysanoptera have been well summarised by Ramakrishna & Margabandhu (1940) and Margabandhu & Ananthakrishnan (1953). An exhaustive review on the subject is not within the scope of the present paper, hence, only those papers that have been cited here are given under references. References of taxonomic importance are listed under each species ; others are given at the end.

## III. Localities of collections

The Thysanoptera collections have been made in the following localities. The altitude is given in metres above mean sea-level.

| | |
|---|---|
| *Kerala :* | Munnar [1565 m.] |
| *Madras :* | Coimbatore ; Kodaikanal [2125 m.] ; Madras ; Mt. Stuart (Top-slip) [760 m.] ; Ootacamund (Ooty) [2678 m.] |
| *Maharashtra :* | Hadpsara ; Mahabaleshwar [1461 m.] ; Poona. |
| *Mysore :* | Jog (Gersoppa) Falls [258 m.] |

## IV. List of Species recorded

Species recorded during the survey are arranged alphabetically. Those recorded for the first time in India are marked with a dagger [†]. Those new to the National Zoological Collections of the Zoological Survey of India are marked with an asterisk [*].

1. *Aeolothrips collaris* Priesner
2. *Anaphothrips flavicinctus* (Karny)
3. *Dendrothripoides ipomeae* Bagnall
*4. *Haplothrips ganglbaueri* Schmutz
*5. *H. schultzei* Priesner
6. *Haplothrips* sp.
7. *Mallothrips indicus* Ramakrishna
*†8. *Pnigmothrips medanensis* Priesner
9. *Retithrips syriacus* (Mayet)
10. *Rhipiphorothrips cruentatus* Hood
*11. *Taeniothrips nigricornis* Schmutz
*12. *Thrips kodaikanalensis* Ananthakrishnan & Jagdish
13. *Thrips* (*Isothrips*) *orientalis* Bagnall

## V. Host Species

The collections were made on the following host plants :

| | | |
|---|---|---|
| 1. | Anacardiaceae | .. *Mangifera indica* L. |
| 2. | Araceae | .. *Pothos scandens* L. |
| 3. | Combretaceae | .. *Terminalia* sp. near *marbellarica* Roxb. |
| 4. | Compositae | .. *Artemisia scoparia* Waldst. & Kit. (Marathi : gazara) |
| 5. | Convolvulaceae | .. *Ipomoea campanulata* L. |
| 6. | Gramineae | .. *Triticum vulgare* Vill. |
| 7. | -do- | .. *Zea mays* L. |
| 8. | Hypericaceae | .. *Hypericum mysorense* Wight & Arn. |
| 9. | Leguminosae | .. *Sesbania grandiflora* Pers. |
| 10. | Melastomaceae | .. *Tibouchina semidecandra* Cogn. |
| 11. | Meliaceae | .. *Azadirachta indica* A. Juss. |
| 12. | Moraceae | .. *Ficus religiosa* L. |
| 13. | -do- | .. *Ficus* sp. ? (Marathi : chatranz) |
| 14. | Oleaceae | .. *Jasminum mesnyi* Hance [*J. primulinum* Hemsl.] |
| 15. | Rosaceae | .. *Rosa* spp. |
| 16. | Solanaceae | .. *Datura suaveolens* Humb. & Bonpl. |
| 17. | -do- | .. *Solanum wightii* Nees |
| 18. | Thymelaeaceae | .. *Lasiosiphon eriocephalus* Decne. |
| 19. | Verbenaceae | .. *Petraea volubilis* L. |

## VI. Notes on Species

Notes on the thrips recorded are given under each species. The families are arranged following Priesner's (1949) classification in alphabetical sequence. The subfamilies, genera, and species are also arranged under each family in alphabetical sequence. Under each species the first reference and only the more important synonymies are listed. The subfamilies included here are from different sources. All the specimens except where otherwise stated have been preserved in alcohol. The Zoological Survey of India has been abbreviated as Z.S.I. The collector's name has been abbreviated as K. V. L. Narayana for brevity.

### Family Aeolothripidae Uzel

### Genus *Aeolothrips* Haliday 1836

### **Aeolothrips collaris** Priesner

1919 *Aeolothrips fasciatus* var. *collaris* Priesner, *S.B. Akad. Wiss. Wien.*, 128, p. 119 (March).
1919 *A. fulvicollis* Bagnall, *Ann. Mag. nat. Hist.*, (9) 4, pp. 253-254 (October).
1942 *A. fasciatus* L., Shumsher Singh, *Indian J. Ent.*, 4, pp. 112-114.
1948 *A. collaris* Priesner, *Bull. Soc. Fouad Ent.*, 32, pp. 323, 324, 335 & 338.
1964 *A. collaris* Priesner, Bhatti, *Bull. Ent.*, 5, pp. 17-18.

*Material:* On Wheat (*Triticum vulgare* Vill.) (Reg. No. 3452/H8-2 exs); on *Artemisia scoparia* Waldst & Kit. (?) (Marathi: gazara), (Reg. Nos. 3453/H8-2 exs. & 4251/H8-1 ex.). Hadpsara, 9.II.1962, K.V.L. Narayana coll.

*Notes:* The Z.S.I. has material from Manali to Kote, ' on broad leaves (?) in streams ', Dr. A. P. Kapur coll.

Bagnall (loc. cit.) described this species as *A. fulvicollis* from material collected on *Verbascum* flowers at Kanpur (India, A.D. Imms coll.). Priesner (loc. cit.) described *collaris* as a variety of *A. fasciatus* Linn., and recognised *fulvicollis* as a form of *collaris* (loc. cit.); thus the latter has precedence over the former. Ramakrishna (1928) recorded it on Mango flowers at Pusa (Bihar, D.P.S. coll.); Ramakrishna & Margabandhu (1931) on *Saccharum officinarum*; Shumsher (loc. cit.) recorded it from Delhi under *A. fasciatus* Linn., on *Brassica campestris* var. *dichotami* and var. *sarson* (Cruciferae), *Lathyrus odoratus, L. sativus* flowers; and *Medicago sativa* leaves; Patel *et al.* (1953) recorded it on leaves and leaf sheaths of *S. officinarum* and flowers of *Allium cepa* (onion) in January from Poona, very near to Hadpsara from where the present collections were made. Recently Bhatti (loc. cit.) discussed the taxonomic status of *A. collaris* and *A. fulvicollis* with two new records on *Centaurea cyanea* and *Citrus* spp. from Hoshiarpur (Punjab).

Both wheat and gazara, a compositae fodder crop, are two new hosts recorded during this survey. On the former the thrips were confined to the central shoots; on the latter it was found on young leaves and on flowers. Incidentally, I may mention that on both hosts it was found in association with another species, *Anaphothrips flavicinctus* (Karny).

## Family THRIPIDAE Uzel

### Subfamily Heliothripinae[1] Karny

### Genus *Retithrips* Marchal 1910

### **Retithrips syriacus** (Mayet)

1890 *Heliothrips syriacus* Mayet, *Insects de la Vigne*, p. 451.

1910 *R. syriacus* (Mayet) Marchal, *Bull. Soc. Ent. d'Egypte*, p. 7.

*Material:* On leaves of *Ficus religiosa* L. (Reg. Nos. 3456/H8-3 exs., 4266/H8-3 exs.; and 4310/H8-several exs.; 4199-4200/H8-1 ex. each (on slides), Coimbatore, 14.III.1962, K.V.L. Narayana coll.

*Notes:* In the National Zoological Collections one slide (Reg. No. 1458/H8) containing material from Bapatla (A.P.) on cotton, June 1952, A. R. Seshadri coll., is available.

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[1] Shumsher Singh (1942) raised this subfamily to family rank.

Seshadri & Ananthakrishnan (1954) first reported this species from India on cotton leaves from Cuddalore (E. R. G. Menon coll.), Bapatla (K. R. Mohan Rao coll.) and grape vine from Chingelpet (E. R. G. Menon coll.) ; on leaves of *Cassia auriculiformis* and *Acalypha indica* from Madras (T.N.A. coll.). Ananthakrishnan (1954 b) states that it is a polyphagous, cosmopolitan species, with special preference to castor and cotton leaves, and recorded two additional hosts, Pomegranate and Bauhinia. This author (1956) also worked out the host preferences as well as its incidence on castor.

During the present survey another host, *Ficus religiosa* has been recorded. The heavy incidence and the presence of all stages indicate that this is a true and definitive host.

### Genus *Rhipiphorothrips* Morgan 1913

#### **Rhipiphorothrips cruentatus** Hood

1919 *R. cruentatus* Hood, *Insec. Inscit. menst.*, 7, p. 94.

*Material:* On *Rosa* spp., Hadpsara, 9.II.1962 (Reg. Nos. 3454/H8-10 exs.; 4250/H8-24 exs.); on *Terminalia* sp. near *marbellarica* Roxb., Jog Falls (258 m.s.l.), 18.II.1962 (Reg. Nos. 4192-4193/H8-1 ex. each (on slides) and 4265/H8-2 exs.), K.V.L. Narayana coll.

*Notes :* Hood (loc. cit.) described this species from material collected on grape vine from Coimbatore and careya leaves from Ceylon. Karny (1926) recognised this species from Ramakrishna's collections from calotropis flowers, grape vine, and rose leaves from Coimbatore, *Lannea coromandelica* (*Odina wodier*) from Palur (Madras), and *Syzygium cuminii* (*Eugenia jambolana*) from Maddur (Mysore State). Ramakrishna (1928) on tender leaves of grape vine from Coimbatore, Vijayawada [Bezwada : Andhra Pradesh], and *S. cuminii* from Bangalore and Lyallpur (Pakistan) ; Rahman *et al.* (1937) gave a list of host plants and worked out its biology ; Ramakrishna & Margabandhu (1939b) in addition to the above, reported it on *Punica granatum*, *Terminalia arjuna*, *Mangifera indica*, *Prosopis spicigera* from Lyallpur ; grape vine from Madura and Travancore also (1931). Patel *et al.* (1953) in addition to *T. arjuna* recorded it on *T. catappa* at Anand ; *Psidium guyava* and *Punica granatum* from Poona ; rose and grape at Nasik and Poona respectively. Lakshmi-narayana *et al.* (1961) while recording it on grape vine (*Vitis vinifera*) and country almond (*T. catappa*) from Bapatla ; *Rosa* spp. at Araku valley (Andhra Pradesh), also recorded two new hosts, Cashew and *Eucalyptus* spp., at Bapatla.

During the present survey another species of *Terminalia* was recorded as a host. This, like other *Terminalia* spp., is a true host. Heavy incidence of this species on rose at Hadpsara was noted at the time of my

visit. Hitherto, this species was reported to attack only the leaves; during the present survey severe attacks on flowers were also observed.

Subfamily Panchaetothripinae Bagnall

Genus *Dendrothripoides* Bagnall, 1923

**Dendrothripoides ipomeae** Bagnall

1923 *D. ipomeae* Bagnall, *Ann. Mag. nat. Hist.*, (9) 12, p. 625.

*Material:* On *Ipomoea campanulata* L., Madras, 8.IV.1962 (Reg. Nos. 3457/H8-3 exs. and 4311/H8-7 exs.), K. V. L. Narayana coll.

*Notes:* In the National Zoological Collections one slide is available with details as *Ipomoea* leaf, Trivandrum, Aug. 1955, T.N.A. coll. (Reg. No. 1784/H8). Bagnall (loc. cit.) described this species on *Ipomoea staphylina* from Maddur (Ramakrishna coll.). Ramakrishna (1928) also mentioned its occurrence at Maddur (Mysore).

No other host plant has been recorded so far and *I. campanulata* is a new record. As this is a common hedge plant in south India, it is possible that this species can be met with in other regions as well.

Subfamily Thripinae Karny

Genus *Anaphothrips* Uzel, 1895

**Anaphothrips (Neophysopus) flavicinctus** (Karny)

1912 *Euthrips flavicinctus* Karny, *Marcellia*, 1, p. 115.

1919 *E. citricinctus* Bagnall, *Ann. Mag. nat. Hist.* (9) 4, p. 270.

1931 *A. flavicinctus* (Karny), Ramakrishna & Margabandhu, *J. Bombay. nat. Hist. Soc.* 34 (4), p. 1036.

*Material:* On *Zea mays* (Reg. Nos. 3448/H8-7 exs. & 4246/H8-13 exs.); wheat (Reg. Nos. 3449/H8-3 exs.; 3450/H8-2 exs. and 4309/H8-3 exs.); and *Artemisia scoparia* Waldst & Kit. [Marathi: gazara] (Reg. Nos. 3451/H8-8 exs.; 4252/H7-3 exs.), Hadpsara, 9.II.1962, K. V. L. Narayana coll.

*Notes:* This species is represented in the National Collections from Shahjhanpur, on sugarcane, 20.III.1956, O. P. Singh coll., (Reg. Nos. 1583-1587/H8), and from Madras on guinea grass, Nov. 1955, T. N. Ananthakrishnan coll., (Reg. No. 1781/H8) (on slides).

Originally described by Karny (loc. cit.) from Java. Bagnall (loc. cit.) described the same as *Euthrips citricintus* from one female collected on Arrowroot leaves from Taliparamba (Ramakrishna coll.). Ramakrishna (1928) also recorded it on *Sorghum vulgare* shoots from Coimbatore; Ramakrishna & Margabandhu (1931) on *Pennisetum typhoideum* from Koilpatti (Madras); Shumsher Singh (1942) on paddy

leaf sheaths, *Pennisetum spicatum*, *Saccharum officinarum*, *Triticum aestivum* leaves, *Zea mays* (Gramineae), *Lawsonia inermis*, and tobacco flowers from north India. Patel *et al.* (1953) reported from many places in erstwhile Bombay Presidency, namely on *P. spicatum* from Viramgam and Detroz in September 1950, on leaves and leaf sheaths of *Sorghum vulgare* from Poona, Nasik, Anand, Baroda, Detroz, and Borivili in post-monsoon and early winter months ; on *T. aestivum* at Poona, Bombay, and N. Gujarat ; on *Zea mays* and other grasses from Poona and N. Gujarat. In addition, they recorded it on *Avena sativa* and *Echinochloa stagnina* at Poona ; on leaves of *Cynodon dactylon*, *Eleusine coracona* from Poona and Anand ; on tobacco, tomato, leaf sheaths of *Canna indica* (Cannaceae), and flowers of *Lagasca mollis* (Lobeliae), all from Poona. Ananthakrishnan (1960) recorded it on grasses at Coonoor (5500 ft.) and Shembaganur, Kodaikanal (5000 ft.). According to the latter author this is one of the commonest species of grass-inhabiting thrips exhibiting alary polymorphism with macropterous, brachypterous, and apterous forms. Ananthakrishnan (1961) while recording the degree of incidence of this species on *Andropogon pertusus* and *Panicum maximum* states that it has special preference for guinea grass (*P. maximum*) over other grasses.

One more host, gazara has been recorded now in addition to the already known hosts, i.e. wheat and maize. While on maize and wheat it was found mostly on the tender leaves particularly the central shoots, on gazara it was collected both on tender leaves and on flowers. Further, it was found associated in both cases with *Aeolothrips collaris* Pr.

### Genus *Taeniothrips* Amyot & Serville, 1843

#### **Taeniothrips nigricornis** (Schmutz)

1913 *Frankliniella nigricornis* Schmutz, *S.B. Acad. Wiss. Wien.*, 122, p. 1020.

1922 *Taeniothrips longistylus* Karny, *J. Siam Soc.*, 16, p. 99.

1925 *T. longistylus* Karny, *Bull. Ent. Res.*, 16, p. 125.

1926 *T. longistylus* Karny, *Mem. Dep. Agric. India, Ent.*, 9 (6) pp. 196.

*Material:* On *Azadirachta indica* A. Juss. (Neem), Poona, 7.II.1962 (Reg. Nos. 3443/H8-3 exs. & 4253/H8-4 exs.) ; on *Sesbania grandiflora* Pers., (Reg. Nos. 3444/H8-8 exs. & 4249/H8-8 exs.) ; on *Hypericum mysorense* Wight & Arn., Kodaikanal (2125 m.s.l.), 28-29.III.1962 (Reg. Nos. 4261/H8-1 ex.; 4262/H8-7 exs. and Reg. No. 4201/H8-1 ex. ♀). (on slide), K.V.L. Narayana coll.

*Notes:* The present collection is a new addition to the National Zoological Collections.

Ramakrishna & Margabandhu (1939a) recorded this species on *Mimosa pudica* flowers from Wynaad Hills (2000 ft.). They consider

the possibility of the specimens of *T. longistylus* described by Karny also belonging to this species only. *T. longistylus* was noted on flowers of red gram (*Cajanus indicus*), Sann hemp (*Crotalaria juncea*), shoots of neem (*Melia azadirachta=Azadirachta indica*), lucerne flowers from Coimbatore, and cowpea (*Vigna catiang*) from Taliparamba (Malabar). Ramakrishna (1928) also recorded it on groundnut flowers from Bangalore ; Moulton (1928) on an unidentified plant from Buldana (Berar, H. S. Rao coll.), and Ramakrishna (1934b) on sandal shoots are other records. Bhasin *et al.* (1958) also listed *Azadirachta indica* as a host of *T. longistylus.*

Two new hosts have been noted during the present survey, *Sesbania grandiflora* Pers. (Leguminoseae) and *Hypericum mysorense* Wight & Arn. (Hypericaceae), in addition to neem. On neem it was collected from the underside of the leaves ; on *Sesbania* and *Hypericum* from flowers. The beautiful *Hypericum* flowers were badly infested at the time of my visit. All the flowers had wilted due to desapping. Both plants can also be classed as true hosts.

### Genus *Thrips* Linnaeus, 1761

#### **Thrips kodaikanalensis** Ananthakrishnan & Jagadish

1966 *T. kodaikanalensis* Ananth. & Jagadish, *Ent. Tidskrift* 87. 1-27 : 85-99.

*Material:* On *Datura suaveolens* Humb. & Bonpl. (Solanaceae), Munnar, (1565 m.s.l.), 20.III.1962, (Reg. Nos. 4194-4196/H8-3 exs.) (on slides) & (Reg. No. 4263/H8-12 exs.) ; on *Tibouchina semidecandra* Cogn., Kodaikanal, 28.III.1962 (Reg. No. 4264/H8-5 exs), K. V. L. Narayana coll.

*Notes :* Originally recorded on an unidentified host plant.

According to Dr. Ananthakrishnan (personal communication) this is one of the most common species of thrips in south India. *Tibouchina semidecandra* Cogn. and datura may be classified as true hosts in view of the abundance of the specimens as well as symptoms of attack on these hosts.

#### **Thrips (Isothrips) orientalis** (Bagnall)

1915 *Isoneurothrips orientalis* Bagnall, *Ann. Mag. Nat. Hist.*, (8) 15, p. 593, pl. 32, fig. 1.

1926 *Isoneurothrips orientalis* Bagnall, Karny, *Mem. Dep. Agric. India, Ent.*, 9 (6), p. 197, pls. 17-18, figs. 1 & 8.

1940 *Isothrips* Priesner, *Bull. Soc. Fouad Id' Egypte*, p. 54.

*Material :* On *Jasminum mesnyi* Hance [=*J. primulinum* Hense] Ootacamund [Ooty], (2678 m.s.l.), 11.III.1962, (Reg. No. 3458/H8-12 exs. ; 4247/H8-3 exs.), K. V. L. Narayana coll.

*Notes:* The National Zoological Collections had a slide (Reg. No. 124/H8) of this species under *Isoneurothrips orientalis* Bagnall on Jasmine flowers, Coimbatore, 1923, T.V.R. coll.

Bagnall (loc. cit.) described this species from material collected on a white flower from Mt. Matanga, Sarawak (G. E. Bryant coll.). Unfortunately, the specimen studied by Bagnall was imperfect. Hence, Karny (loc. cit.) redescribed it after studying several specimens from flowers of *Morinda tinctoria* and Jasmine in Ramakrishna's collections from Coimbatore. Ramakrishna (1928) also mentioned it on Jasmine. Ramakrishna & Margabandhu (1939a) recorded it from Bombay and Poona. Priesner (loc. cit.) created a new subgenus *Isothrips* under genus *Thrips* L., with *I. orientalis* Bagnall as the type of the subgenus. Patel *et al.* (1953) also recorded it on Jasmine from Poona and it was also listed by Mathur *et al.* (1960a) on *Jasminum* spp.

It is believed that *J. mesnyi* is a new host species, as it is a rare plant and perhaps the earlier records are all on the usual ornamental varieties only.

## Family PHLAEOTHRIPIDAE Uzel

### Subfamily Cryptothripinae Karny

### Genus *Mallothrips* Ramakrishna, 1928

#### **Mallothrips indicus** Ramakrishna

1928 *M. indica* Ramakrishna, *Mem. Dep. Agric. India Ent.*, 10 (7), pp. 308-310, fig. 31.

*Material:* On *Ficus* sp., Mahableshwar (1461 m.) 14.II.1962 (Reg. Nos. 3455/H8-1 ex.; 4248/H8-4 exs.), K.V.L. Narayana coll.

*Notes:* The Z.S.I. collections include two slides, one co-type slide (Reg. No. 424/H8) with 2 exs. *Eugenia* sp. from S. India, T.V.R. coll., and another on *Eugenia* sp., Kanpur, Ramakrishna coll.

Ramakrishna (1928) described the new genus and species from material collected by him in leaf galls of *Syzygium cuminii* (*Eugenia jambolana*) from Coimbatore and identified them from specimens collected by D. S. Chaudhury also from Kanpur on the fruits of the same plant (?) (Ramakrishna 1934a). Ananthakrishnan *et al.* (1965) while recording this species on *E. jambolana* from Tirupati (A.P.) & Pondicherry, state that it has been hitherto believed to make galls on *Eugenia* leaves but the actual gall producer is a psyllid. The adults gain entry when the galls are dried and cracked.

The present record is from pouch galls also made by a psyllid on the dorsal lamina of *Ficus* leaves.

## Subfamily Haplothripinae Karny

### Genus *Haplothrips* Amyot & Serville, 1843

### **Haplothrips ganglbaueri** Schmutz

1913 *H. ganglbaueri* Schmutz, *S.B. Akad. Wiss. Wien.*, p. 1034.

1916 *H. ganglbaueri* Schmutz, Karny, *Mem. Dep. Agric. India, Ent.*, 9 (6), pp. 217, fig. 18, pl. 21, (fig. 1).

1933 *Haplothrips* sp. Priesner, *Rec. Indian Mus.*, 25 (4), p. 355.

*Material:* On *Petraea volubilis* L., Poona, 6.II.1962, (Reg. Nos. 3445/H8-3 exs.; 4308/H8-1 ex.); on *Solanum wightii* Nees, Poona, 8.II.1962 (Reg. Nos. 3446/H8-5 exs.; 4312/H8-4 exs.), K. V. L. Narayana coll.

*Notes:* This species is new to the National Collections. Karny (1926) studied this species collected by Ramakrishna on a wild plant at Coimbatore. Ramakrishna (1928) recorded it on Jasmine flowers from Kollegal. He observed the occurrence of apterous and brachypterous forms also. Priesner (loc. cit.) dealt in detail with the species of *Haplothrips* from Indo-Malayan region and mentioned that this species occurs chiefly in Japan, Sumatra, and Krakatov Island.

The two hosts, *Petraea volubilis* L. (Verbenaceae) and *Solanum wightii* Nees (Solanaceae), are two new hosts recorded now. On both only the flowers were attacked. The infestation on *Petraea* was very heavy. The thrips as well as aphids present at the time of the author's visit almost desapped the blue flowers and they turned brown and scorched.

### **Haplothrips schultzei** Priesner

1910 *H. aculeatus* Schultze, *Zool. anthropol. Erg. Porschungor Westl. O. centr. Sud-afrika.*, 4, pp. 147-174.

1921-22 *Haplothrips* sp. Priesner, *Treubia*, 2, p. 17, fig. 7.

*Material:* On Mango, Poona, 8.II.1962 (Reg. No. 3442/H8-1 ex.), K. V. L. Narayana coll.

*Notes:* This species is represented in the National Collections as *H. aculeatus* F. collected on *Cyperus* sp. from Hokuto, Formosa, 5.XII.26, Takahashi coll. (Reg. No. 132/H8-on slide).

Only a single example was collected on sweeping mango inflorescence. Obviously, this host should be considered as nichtwirte (non-host).

### **Haplothrips** sp.

1843 *Haplothrips* Amyot & Serville, *Hist. Ins. Hemipt.*, p. 640.

1918 *Haplothrips* (Synonymy notes) *Hood, Mem. Qd. Mus.*, 6, p. 126.

1921-22 *Haplothrips* (studies) Priesner, *Treubia*, 2, pp. 1-20, 7 figs.

1921-22 Priesner's *Haplothrips* studies, Karny, *Treubia*, 2, pp. 21-36.

1933 *Haplothrips* (Indo-Malayan studies) Priesner, *Rec. Indian Mus.*, 35 (3), pp. 347-369.

*Material :* On *Lasiosiphon eriocephalus* Decne., Mahabaleshwar (1461 m.), 14.II.1962 (8 exs. and 2 exs. on slide not registered), K. V. L. Narayana coll.

*Notes :* The National Zoological Collections have slides of *H. aculeatus* F. (now *H. schultzei* Pr.) on *Cyperus* from Formosa, R. Takahashi coll. (Reg. No. 132/H8) ; *H. ceylonicus* Schmutz, from Buldana (Berar) H. S. Rao coll. (Reg. No. 85/H8) ; *H. euphorbiae* Pr., on *Euphorbia hirta* from Kallar, T.N.A. coll. (Reg. No. 2581/H8) ; *H. gowdeyi* (Franklin) on lantana blossoms from Honolulu, Hawaii, O. H. Swezey coll., and *Haplothrips* sp. on Peach, J. P. Chatrath coll.

Priesner (loc. cit.) gave a brief account on this genus and in 1933 dealt with, in detail, the Indo-Malayan species. Karny (1926) discussed many species of *Haplothrips* from India. Ramakrishna (1928) stated that this genus is represented in India by numerous species and includes the commonest among tubulifera found in flowers. He added that some of them are so very closely related to each other that it is often difficult to separate them.

It was not possible to identify the specimens under report as they are badly damaged. However, it may be mentioned that they inhabited flowers.

## Genus *Pnigmothrips* Priesner, 1953

### **Pnigmothrips medanensis** Priesner

1953 *P. medanensis* Priesner, *Treubia* 22, pp. 357-380.

*Material :* On *Pothos scandens* L., Mt Stuart [Top-slip] (760 m.s.l.), 17.III.1962 (Reg. Nos. 4197-4198/H8-2 ♀♀ exs. (on slides) (Reg. No. 4267/H8-12 exs.), K. V. L. Narayana coll.

*Notes :* This species is a new addition to the National Zoological Collections and also a new record from India.

Priesner (loc. cit.) described it as a new genus and species, from Sumatra (SE. coast) Batang Serangan Virgin forest, December 1923, in leaf galls (herbarium No. 23), L. Fulmek coll. According to this author, this genus comes close to *Eugynothrips* differing by the slightly enlarged fore femora of both sexes, the unarmed fore tarsi of the male, and the shape of the head and the contracted neck (hence *Pnigmothrips*).

The present material was collected in leaf galls on *Pothos scandens* L. (Araceae). The leaves are folded over the mid rib on the epiphyllous side, crumpled, twisted, and mottled badly. The infestation was so heavy, that bunches of leaves were drooping and hanging loosely due to desapping and gall formation. Old infested leaves finally become yellow and brittle.

## Part II

## VII. Thysanoptera complex of the recorded host plants

The Thysanoptera complex of the host plants recorded during the present survey is discussed hostwise arranged alphabetically according to families.

### Anacardiaceae

#### **Mangifera indica** L.

Bagnall (1919) mentioned *Aeolothrips fulvicollis* Bagnall (now *A. collaris* Pr.) on mango flowers. Karny (1926) identified *Haplothrips ceylonicus* Schmutz from Ramakrishna's collection at Coimbatore. Ramakrishna (1928) recorded *Ramaswamiahiella subnudula* Karny as well as *H. ceylonicus* Sch. at Coimbatore and Anakapalli (A.P.). He also described *Liothrips kiriti* from mango leaves. Ramakrishna *et al.* (1939a) described *Oxyrrhinothrips beharensis* Ramk. & Marg., now *Thrips* (*Oxyrrhinothrips*) *beharensis* (Ramk. & Marg), and recorded (1939b) *Rhipiphorothrips cruentatus* Hood on mango leaves and *Podothrips javanus* Priesner on mango inflorescence from Coimbatore. Patel *et al.* (1953) recorded *Scirtothrips dorsalis* Hood at Anand. Mathur & Singh (1960b) in addition to the above also listed *Heliothrips haemorrhoidalis* (Bouche) and *Selenothrips rubrocincta* (Giard) on leaves.

*Haplothrips schultzei* Priesner now recorded at Poona was found on mango inflorescence. In the light of Markkula's classification of host plants this plant may be classified as Nichtwirte or non-host.

### Araceae

#### **Pothos scandens** L.

Only two species are hitherto known to be associated with this plant, namely, *Tetradothrips folliperda* (Karny), (*Eothrips folliperda* Karny), and *Mesothrips melinocnemus* Karny from Taliparamba, causing leaf galls. Ramakrishna (1928) states that in the case of the former species

the foliage often suffers very seriously. The leaf rolls up longitudinally and its colour gradually changes to a sickly yellow ; in the later stages the galled leaf becomes brittle. Ananthakrishnan *et al.* (1965) recorded *Gynaikothrips pallicrus* Karny from *Pothos scandens* leaf galls along with the gall maker *Tetradothrips folliperda* (Karny) and *Mesothrips melinocnemus* Karny from Moodbidri near Mangalore (Mysore State).

*Pnigmothrips medanensis* Priesner, now recorded for the first time from India, also produces galls on the leaves. The leaf folds on the epiphyllous or axial side over the mid-rib, and becomes twisted, yellowed, and brittle. It may be mentioned that the yellowing is gradual. This plant in view of the heavy infestation appears to be a true host.

## COMBRETACEAE

### **Terminalia** sp. near **marbellarica** Roxb.

No record of any species on this host is available. However, there are records on closely allied species. Karny (1926) described *Rhynchothrips pallipes* from Travancore collected by Ramakrishna in *Megatrioza hirsuta* C. (Psyllidae) gall on *Terminalia* sp., and *Gynaikothrips interlocatus* Karny from the same locality and from psyllid galls. Ramakrishna (1928) in addition to the above, mentioned *Androthrips flavipes* Schmutz inside psyllid galls on *Terminalia* spp. He also described *Rhipiphorothrips karna* on a related species *T. catappa*, from Malabar. Ramakrishna & Margabandhu (1939b) reported the occurrence of *R. cruentatus* Hood on *T. arjuna*. Patel *et al.* (1953) and Lakshminarayana *et al.* (1961) recorded the latter species on *T. catappa* at Anand and Bapatla respectively. The latter species of thrips is now recorded on *Terminalia* sp. near *marbellarica* Roxb., during the present survey.

## COMPOSITAE

### **Artemisia scoparia** Waldst. & Kit. [Marathi : gazara]

No record of any species on this fodder crop is available. Two species, *Aeolothrips collaris* Priesner and *Anaphothrips* (*Neophysopus*) *flavicinctus* Karny, were found infesting both the tender leaves as well as flowers at Hadpsara (Maharashtra).

## CONVOLVULACEAE

### **Ipomoea campanulata** L.

No species has been recorded on this host plant.

Bagnall (1923) described *Dendrothripoides ipomeae* from a related host *I. staphylina* from Maddur. Ramakrishna (1928) recorded the above species as well as *Taeniothrips* (*Physothrips*) *minor* (Bagnall) on *I. staphylina*. Ramakrishna *et al.* (1939b) recorded *Frankliniella*

*sulphurea* Schmutz on Convolvulus flowers at Lyallpur, which is extremly polyphagous (Ananthakrishnan 1960). Patel *et al.* (1953) also recorded the latter species on *Ipomoea* sp. and *Achaetothrips mundus* (Karny) on sweet potato (*I. batatas*) at Poona. Mathur *et al.* (1960a) listed *Frankliniella persetosa* Karny and *Thrips japonicus* Bagnall on *Ipomoea* sp.

## GRAMINEAE

### **Tricticum vulgare** Vill. and **Zea mays** L.

*Ramakrishnothrips jonnaphilla* (Ramakrishna) has been recorded on *Zea mays* at Guntur (A.P.) by Ramakrishna (1928). *Anaphothrips flavicinctus* (Karny) has been recorded on *Zea mays* cobs as well as *Triticum aestivum* by Shumsher (1942). Patel *et al.* (1953) recorded it on *Zea mays* from Poona and N. Gujarat as well as on *T. aestivum* both from the latter locality as well as Bombay. They also recorded *A.* (*Dantabahuthrips*) *sacchari* Shumsher on *Zea mays.*

During the present survey *Aeolothrips collaris* Pr. has been recorded on wheat (*T. vulgare* Vill.) for the first time along with *A. flavicinctus* (Karny) at Hadpsara near Poona. The infestation was mostly confined to the central shoots on both plants. They can be safely included under true hosts.

## HYPERICACEAE

### **Hypericum mysorense** Wight & Arn.

No record of any thrips species is known from this host plant. The plant is an ornamental one growing 4-6 ft. with fine yellow flowers, extending from Konkan to Palni Hills at 3000-5000 ft.

*Taeniothrips nigricornis* (Schmutz) recorded during the present survey from Kodaikanal is the only known species on this host plant, which can be rightly included under true host category.

## LEGUMINOSAE

### **Sesbania grandiflora** Pers.

Karny (1926) recorded *Eurhynchothrips ordinarius* (Hood) from flowers of this plant. Ramakrishna (1928) recorded *Heliothrips indicus* Bagnall in addition to *E. ordinarius* on a related species, *S. aculeata,* and described *Brachythrips dirghavadana* on another closely allied species, *S. aegyptiaca.* Ananthakrishnan (1954b) described *Perissothrips aureus* from Ramakrishna's collections on *S. aegyptiaca.* Mathur *et al.* (1961) also listed *B. dirghavadana* Ramk. and *E. ordinarius* (Hood) on *S. aegyptiaca* and

*S. grandiflora* respectively, the former on the foliage and the latter on flowers.

Thus the present record of *T. nigricornis* (Sch.) adds one more species associated with *S. grandiflora*. Infestation was confined to the flowers only. This is a true host for this species.

### MELASTOMACEAE

**Tibouchina semidecandra** Cogn.

No thrips has so far been recorded on this plant and *Thrips kodaikanalensis* Ananth. & Jagadish recorded now is the first known species from this host. Most of the flowers were dried up due to desapping, which is clearly seen on the petals.

### MELIACEAE

**Azadirachta indica** A. Juss.

Karny (1926) and Ramakrishna (1928) recorded *Heliothrips haemorrhoidalis* (Bouche) on the shoots of neem (*Melia azadirachta*) at Coimbatore. The latter also noted *Dicaiothrips* (now *Elaphrothrips* Buffa.) on *Melia indica* (now *A. indica*) from Dehra Dun (Champion coll.). Bhasin *et al.* (1958) listed the above species only. *Taeniothrips nigricornis* Sch., recorded during the present survey, has been collected on the underside of the leaves, though on other plants it was collected from flowers. A new host record for this common pest.

### MORACEAE

**Ficus religiosa** L. and **Ficus** sp.

So far only two species of thrips, *Dichaetothrips beesoni* Moulton (Moulton 1928, and Mathur *et al.* 1959) and *Dendrothripiella* (*Projectothripoides*) *pandai* Shumsher (Shumsher 1942) were recorded on this host. But many records from related hosts are known. Karny (1926) described *Mesothrips apatelus* from *Ficus retusa* and mentioned two more species, *Gynaikothrips uzeli* Zimm. and *G. elegans* Zimm. He also described varieties of *Androthrips flavipes* Schmutz on the same host. Ramakrishna (1928) mentioned *G. elegans* Zimm. on different species of *Ficus*; *G. uzeli* Zimm. on *F. retusa*; *Androthrips flavipes* Sch. in leaf galls of *F. retusa* along with *G. elegans*, and described *Brachythrips dirghavadana* from *retusa* leaf galls; *G. malabaricus* from rolled banyan leaves (*F. indica*); and *Mesothrips bhimabahu* on *retusa* leaf galls. Ananthakrishnan (1951, 1960) recorded *Gigantothrips ochroscelis*

Priesner on *F. heterophylla* and *Cercothrips tibialis* (Bagnall) on *F. bengalensis*. Mathur *et al.* (1959) listed the above species on different *Ficus* plants as well as two more species, *Leptothrips constrictus* Karny and *Mesothrips jordani* on *F. benjamina*. Ananthakrishnan *et al.* (1965) recorded *Androthrips flavipes* Sch., in galls on *Ficus* sp. produced by *Gynaikothrips flaviantennatus* Moulton and in the leaf galls of *F. benjamina* produced by *G. uzeli* Zimm. from Calicut, Agumbe Ghat Road, and Courtallum with peak incidence during January-March ; *Arrhenothrips dhumrapaksha* Ramk. from Agumbe Forest Ghat Road (Mysore) in the leaf fold galls on *F. retusa* in galls resembling that of *G. uzeli* Zimm. ; the latter species from Burliar (Nilgiris), Courtallum, and Agumbe Forest Ghat Road ; *G. malabaricus* from rolled tubular galls on *Ficus* sp., from Yercaud (Salem) and Guindy (Madras) ; *G. moultoni* Ramk. from Salem on *Ficus* sp. ; *Liothrips hradecensis* Uzel on *F. benjamina* galls along with *G. uzeli* and *A. flavipes* from Courtallum and *Mesothrips jordani* Zimm. in leaf galls on *Ficus* sp. at Courtallum.

The present record of *Retithrips syriacus* (Mayet) (of all stages) is a new record on *F. religiosa* and this plant could well be considered as a true host.

During this survey *Mallothrips indica* Ramakrishna, hitherto known from *Syzygium* spp. (*Eugenia*) was recorded in psyllid galls on *Ficus* spp.

## OLEACEAE

### **Jasminum mesnyi** Hance. [=*J. primulinum* Hemsl.]

This plant is an evergreen twiggy shrub, a native of Yunnan, extensively cultivated throughout the Tropical and Sub-tropical parts of the world. The flowers are solitary and primrose yellow in colour. It is not known in the wild state in India but only grown as an ornamental plant for its large scentless flowers, which appear from March to May. The collections were made in the Botanical Gardens, Ooty. Being a rare plant no record of any species on this particular host is available. However, records from other common cultivated varieties are available as follows :

Karny (1926) noted *Haplothrips ceylonicus* and *Thrips* (*Isothrips*) *orientalis* Bagnall on jasmine flowers. Ramakrishna (1928) recorded *Frankliniella sulphurea* Schmutz, *H. ganglbaueri* Schmutz, and *T.* (*I*) *orientalis* Bagnall on jasmine. Ramakrishna *et al.* (1939a) recorded the last species on jasmine, and also another species *Dendrothripiella jasminum*, from jasmine. Ananthakrishnan (1953, 1954a) recorded *H. veroniae* Pr. and *Eothrips aswamukha* Ramk. on jasmine leaf galls (M. S. Mani coll.). Mathur *et al.* (1960a) also listed *T.* (*I*) *orientalis*

Bagnall and *T. florum* Sch. on jasmine flowers. The former is now recorded for the first time on *J. mesnyi* flowers.

## ROSACEAE

### **Rosa** spp.

Bagnall (1918, 1926) described *Haplothrips tenuipennis* and *Thrips melaneurus* on rose from Darjeeling. Karny (1926) mentioned *Rhipiphorothrips cruentatus* Hood. Ramakrishna (1928) recorded *Taeniothrips* (*Physothrips*) *andrewsi* Bagnall and *T. brunneicornis* (Bagnall), *T.* (*Physothrips*) *lefroyi* Bagnall, and *Thrips florum* Sch. Ramakrishna *et al.* (1939a) recorded *Frankliniella sulphurea* Schmutz. Shumsher Singh (1945) described *Taeniothrips rhopalantennalis* on rose (M. S. Mani coll.). Ananthakrishnan (1953) identified *Thrips florum* Sch. from specimens collected by K. K. Nayar, from Trivandrum ' causing galls on leaves of rose ' and states that this is the first record of the species on this plant causing galls. He (1960) recorded this species on *Rosa* spp. at Ooty ; *T. tabaci* Lind. and *T. melaneurus* Bagnall on *Rosa bankia* at Kodaikanal. Mathur *et al.* (1960c) also listed the above species. Lakshminarayana *et al.* (1961) recorded *R. cruentatus* Hood on *Rosa* spp. at Araku Valley (A.P.).

During the present survey *R. cruentatus* Hood was found infesting and feeding on rose flowers, in addition to the leaves.

## SOLANACEAE

### **Datura suaveolens** Humb. & Bonpl.

Popularly known as Angel's Trumpet, this handsome shrub growing to a height of 10-15 ft. and native of Mexico is grown in Indian gardens for its 8-12 inch long sweet-scented, drooping flowers. It blooms during the hot season. So far, no thrip species is recorded on this host.

Only two species are hitherto recorded on closely related species, Karny (1926) and Moulton (1929) recorded *Frankliniella sulphurea* Sch. on datura flowers. Ramakrishna (1928) recorded *Tryphactothrips rutherfordi* (Bagnall) on datura flowers and Ramakrishna *et al.* (1939a) recorded *F. sulphurea* Sch. on *D. fastuosa*. Mathur *et al.* (1959) listed *T. rutherfordi* (Bagnall) on datura flowers.

*Thrips kodaikanalensis* Ananth. & Jagadish is now recorded for the first time on *D. suaveolens*.

**Solanum wightii** Nees

No thrips is known to attack this plant and the present record of *Haplothrips ganglbaueri* Sch., on both flowers and leaves, is the first record.

## Thymelaeaceae

**Lasiosiphon eriocephalus** Decne.

This small tree or much-branched shrub (1·8-3·0 m.) is found in open forests on the hills of the Deccan and Western Ghats from Konkan southwards to Kerala, Nilgiris, Palnis, and Tinnevelly Hills at altitudes of 1200-2100 m. ; with small yellow flowers densely arranged on a terminal inflorescence. It yields a fibre useful in paper technology and serves as a fish poison. It causes dermatitis to human beings and hence is of considerable medical importance also.

No Thysanoptera has so far been recorded on this plant and the only known record is the present case of *Haplothrips* sp. As the specimens are all damaged, they could not be identified further.

## Verbenaceae

**Petraea volubilis** L.

No Thysanoptera has been recorded on this plant. Heavy infestation of *Haplothrips ganglbaueri* Sch. and aphids completely desapped the flowers, which appeared scorched. This is the only known case of thrips infestation on this plant.

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# The Yellow-wattled Lapwing, *Vanellus malabaricus* (Boddaert), a tropical dry-season nester

## III. Two further seasons' breeding

BY

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(*With two plates and two text-figures*)

### Introduction

In two previous papers (Jayakar & Spurway 1965 *a* and *b*—henceforth referred to simply as *a* and *b* respectively) we have presented data on the breeding biology of *Vanellus malabaricus* (Bod.) collected in Bhubaneswar, Orissa, during the two years 1963 and 1964. This paper adds and discusses the data collected during the years 1965 and 1966.

We have followed Ripley (1961) in accepting Bock's (1958) submergence of genera relevant to this discussion in Brisson's genus *Vanellus*. However, the generic names used in the publications which we cite will be given.

However, the species here considered differs considerably from several previously described. For comparison with the well known Palaearctic *Vanellus vanellus* (L.) we rely on a recent account by Nethersole-Thomson (1961) which we will refer to henceforth as N-T, and for the South African species *V. armatus* (Burchell), classified in the genus *Hoplopterus*, on Hall (1959 and 1964).

### Desertion and establishment of territories

Nesting activities have rapidly disintegrated with the beginning of the monsoon in mid-June. This is not an abrupt date in this part of India. No month is entirely without rain, and sufficient rain falls in a satisfactory year for rice planting to have begun before the rain due to the

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wind called the monsoon. With the increasing rain in June, birds who have not reared a brood have continued to lay. These late clutches not only have not hatched, but usually disappear within a few days, though in 1966 a clutch of 4 persisted 19 days the last egg being laid between 17·35 on 25/vi and 08·52 on 26/vi, and the clutch disappearing between 18·04 on 15/vii and 12·58 on 16/vii.

The parent birds with their full grown, flying, but mottled, chicks disappear from their territories (Plate I, Fig. 1 shows a 21 day old chick, not yet flying). Small flocks, some of which are too large to be family parties have been seen into July in the gardens described in *a* and *b*.

From this time until the latter half of September, *malabaricus* is absent or much rarer in the locality studied (see map in *b*).

During this time they could always be found on the waste land definitively outside the town, in flocks of not more than 12 individuals. This is a major difference from *vanellus* of which flocks of 200 have been counted (N-T) in the breeding area, but outside the breeding season. The flocks of *armatus* may reach 40, and, from Hall's map (1959, p. 118), seem to be concentrated in a smaller and more urban area than the breeding pairs. Hall writes of flocks 'dispersing' to breed.

The distances moved by an individual *malabaricus*, though regular in time, are perhaps too small for the species to qualify even as a local migrant, whereas *vanellus* is a typical migrant wintering over the old world roughly as far south as the Tropic of Cancer (Baker 1929). This important difference between the two species seems an ecological adaptation.

From mid-September such flocks of *malabaricus* have returned to the study area in increasing numbers. The number of individuals in a flock have steadily decreased as the breeding season approached. In January, the earliest month in which eggs have been recorded, 3 birds have been observed together without any display. The area exploited for breeding seemed to become divided into territories solely by the disappearance of this third bird, and immediately after the reduction of a group to two, copulation, scrape making, agonistic behaviour and laying began at once. No common ground was observed to exist between which and their several territories the several pairs could move freely, as described by Howard (1920) for *vanellus*.

These processes are surprisingly undemonstrative. The species nests within 27 m. of the house, and has been watched sufficiently often at sufficient hours and seasons to be certain that there is no aerial display like that of *vanellus* (N-T) which has given that species and by extension the whole subfamily one of its English names.

No agonistic behaviour to separate males nor courtship to hold females within a territory has been observed. Very few scrapes have been recognised with certainty which were never used for eggs. How-

ever, there was once in 1965 a gap of 38 days between our recognising a scrape and our first finding an egg in it, although the pair concerned (No. 13) had in the intervening period made, laid, and lost eggs in, another scrape. Courtship of unmated females by the making of several scrapes which are displayed, or in which the males display, only one of which is selected and used, as is performed by *vanellus* (N-T) and *armatus* (Hall 1964) is not important, at least in this population of *malabaricus*.

That courtship has not been observed may be because pairs have been relatively permanent (*b* and below) though N-T implies that when male and female *vanellus* return to a territory which they themselves have held and used during a previous season, they arrive separately, and the male courts the female, among others, like a stranger.

## Area and persistence of territories

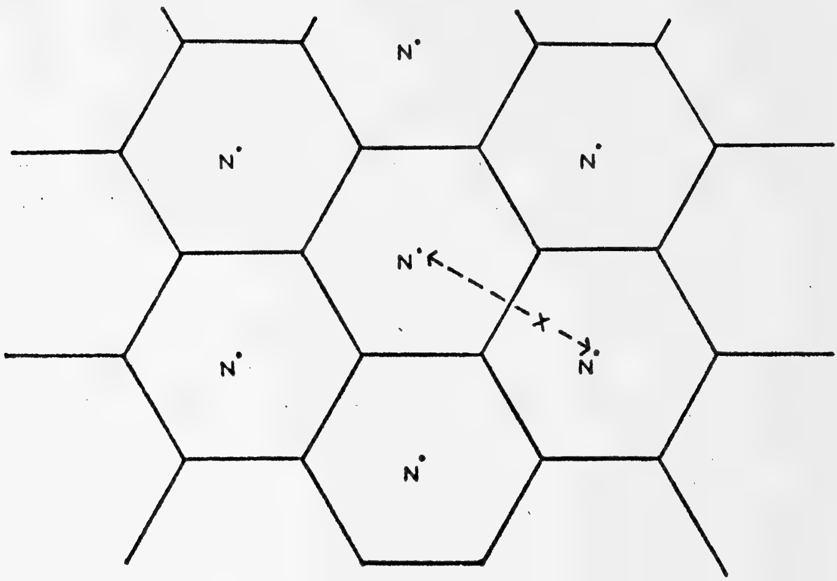
In 1964 (*b*) 2 territories were entirely in the area under observation, in 1965, 4 and in 1966, 2. We have previously described (*b*) how and why the perimeter of a territory has altered during a season, as the birds literally lost interest in parts of it because their activities were concentrated elsewhere.

Territorial boundaries have, so far, always been surrendered by default, and not after one or more displays of agonistic behaviour.

The average area surrounded by these 8 maximum perimeters is $4{\cdot}10 \pm 0{\cdot}54$ hectares, or just over 10 acres. Hall (1959) calculated the minimum area of territory for the Cape Spurwing *V. armatus* as follows, 'No nests have been found simultaneously occupied by pairs closer together than *c.* 400 yards. Thus the minimum territory size may be estimated at 40,000 square yards'. How he obtains the latter figure is not explained. We would calculate as follows. Assuming theoretically a grid of nests all equidistant from each other, with each territory being a regular hexagon with the nest as the centre as shown in Fig. 1, the area of each territory in this figure would be $\frac{x^2\sqrt{3}}{2}$, where $x$ is the distance between two proximate nests.

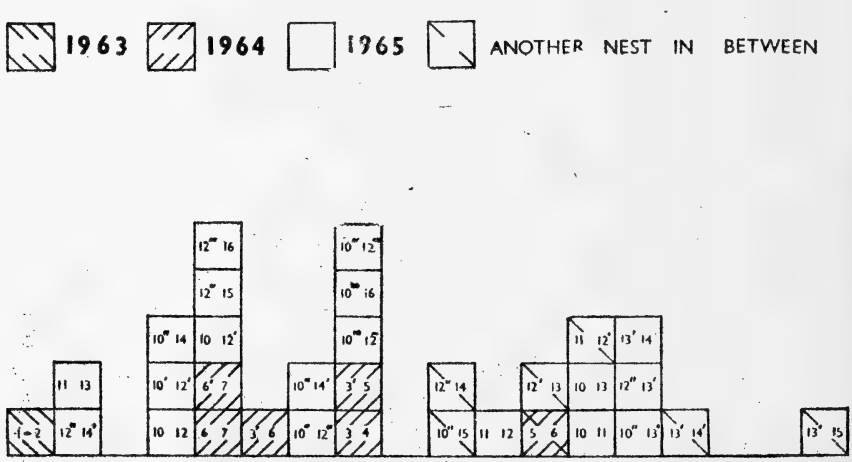
Though we know that *malabaricus* nests tend to be at the edge of territories, we have graphed (Fig. 2) the distances between contemporaneous nests, from our 1964 and 1965 maps (nests were not mapped in 1966). This gives a multimodal histogram. Most of the largest distances on the extreme right are those in which another nest could be reasonably considered as being between the two considered. This is biologically not meaningful. The smallest distance, on the extreme left, is the only one recorded in 1963. It is included because it is an extreme value. There was a natural boundary, a hedge, between the two nests (map in *a*). The other two distances in the left-most group had only

*kutcha* roads (or bridle paths) between them. However, these paths may have been used sufficiently to have imposed boundaries accepted by the birds. Taking therefore the next mode, i.e.. the interval 120-125 m., its mid point is at 112·5. Taking 112·5 as $x$ we obtain the minimum




Text Fig. 1 (see text).

territory size for *malabaricus* as 1·10 hectares, or 2·7 acres. Nesting *armatus* adults may fly long distances to feed, whereas *vanellus* has communal feeding grounds close to its nesting territories. The terri-




Text Fig. 2. Distribution of distances (in m.) between contemporaneous nests in 1964, 1965 and 1966.

tories of *malabaricus*, which we believe they do not leave, once established, are a little smaller than those of *armatus* and larger than those of *vanellus*. Even in the dry season insect life is extremely rich in this area, some parts being carpeted with termite galleries.

Nesting pairs have been numbered serially continuing the series from year to year so that a number represents a *pair-season* and, when in doubt, during a season. We have renumbered (*b*)—so the figures for these are almost certainly too high. However, we have excellent evidence that some of the birds were the same individuals who had occupied the same area in previous years, recognised mainly by wattle and resting wing characters such as are discussed in *a*. One male in particular was recognisable as he had (1) a damaged right leg, which was held at an angle when he was standing, caused a limp when walking, and dangled in flight ; (2) a cleft in his wattle ; and (3) a broad black band on his left flank and none on his right. This male has now occupied the same territory with, perhaps minor alterations of boundary in three seasons, 1964 when he was numbered 6, 1965 when he was numbered 12 and 1966 when he was numbered 21. The female of pairs 6 and 12 was probably the same individual (on wing pattern). After his chick had hatched in 1965 this female, 12, disappeared and was not seen for the rest of the season. Male 12 reared at least one chick to flying, single-handed. This is exceptional in *malabaricus* though N-T states it to be frequent in *vanellus*. The female of pair 21 in 1966 was recognisably different.

The location of territories can be constant for several years even when these were occupied by different pairs. A single pair numbered 3 in 1964 and 10 in 1965 used a territory extending over two gardens (see map in *b*) which was almost the same as that held by a different pair 1 (see map in *a*) in 1963, except that in 1964 and 1965 the territory extended through the roughly east-west hedge which in 1963 had been the scene of boundary display and even fighting between pairs 1 and 2. In 1966 a third pair (17) held a territory which coincided with that held in 1964 and 1965 except that the area south of the hedge was further enlarged and nests were made in it for the first time.

Such constancy is probably because a territory is determined by the presence of a certain number of amenities. Of these, the water source, a garden tap has been discussed in *a* and *b*. Such a water source can usually be found in a *malabaricus* territory. It is possible that the various water supplies introduced in the area for building have been an attraction to this species.

## Breeding Economy

Some nests have now been observed which consisted of small dried clods of soil (Plate I, Fig. 2), not of the more usual gravel or twigs (Plate II, Fig. 3).

The earliest date on which an egg has been found was in 1965 on 20/i. The average maximum and minimum temperatures that year for 15 days with this date as midpoint were 28·3° C and 17·3° C. During the breeding season the maximum and minimum air temperatures rise to about 40° C and 30° C. The soil temperatures on which the birds actually incubated rise to over 60° C (*b*).

We have found no eggs contradicting the description made in *a*, though slight differences in ground colour and the amount of spotting, are, as would be expected, characteristic of females. Though all these eggs have been laid on typical bright red lateritic soil we have not yet found the erythristic 'phase' which Baker (1929) considers to be an adaptation to this habitat, and which in mixed populations he considers associated with a capacity to select the ground for a scrape so that the eggs laid in it will be cryptic.

The distribution of the records of clutch size is shown in Table 1. Four is the maximum and also the commonest class. We consider *c*/4 represents a complete clutch as is commonly observed in plovers. However, if 6·3% of clutches are *c*/5 as N-T has observed in his populations of *vanellus*, their absence in a sample of 36 is not significant, especially if, as N-T suggests, they are produced by one or more genotypic variants.

For the 7 completed clutches which we have timed completely the laying took 5 days, i.e., the 4th egg was laid 4 days after the 1st. The interval of 2 days between consecutive eggs has occurred between any 2 of the series. However, the 4th clutch produced by pair 12 (12′′′) consisted of 2 eggs on 13/v and 14/v/65, 3 on 15/v and 16/v while the 4th egg was only laid on 17/v, i.e., 6 days was the minimum period over which it could have been laid.

Table 1 also shows the fate of the eggs. After an incomplete clutch has been lost, the scrape has, with one exception, been deserted. Table 2 shows the timing of clutch replacement. The figures in the body of the table show the number of days between the loss of the first clutch and the laying or finding of the 1st (or for the 3 figures in brackets the finding of 2 eggs) of the immediately replacing clutch. A line *over* the figures indicates that the lost clutch was complete, a line *below* that the replacement clutch was judged complete, for this table, by the birds ceasing laying. The lowest value for this interval when the first clutch was complete is 7 which is, however, a bracketed figure, i.e., a female can recommence laying after 6 or conceivably 5 days. However, this figure was exceptional and 8 or 9 are more usual. The exception was, perhaps significantly, the same clutch 12′′′—the later ovipositions of which were unusually drawn out. When the first clutch was incomplete the female delayed much less, probably only long enough to select a new nest site. In such cases the new

Jayakar : Yellow-wattled Lapwing

Fig. 1. Chick from nest *V.m.* 21—age 21 or 22 days.
[labelled 3]

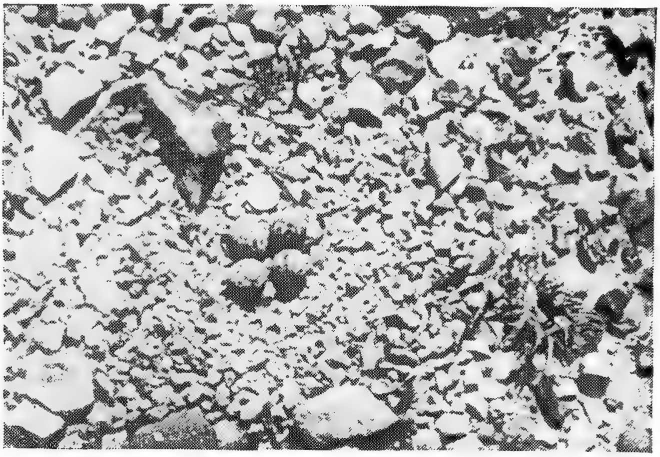


Fig. 2. Nest *V.m.* 17′—a typical nest lined with pebbles.
[labelled 4]

Jayakar: Yellow-wattled Lapwing

Fig. 3. Nest *V.m.* 23—an atypical nest lined with clods of dried earth. [labelled 2]

Fig. 4. Nest of *Vanellus indicus* (*V.i.* 1) containing one egg. [labelled 1]

scrape was barely recognisable when the first egg was laid in it. The interval on the one occasion when the same scrape was immediately reused was 3 days. After these short intervals the replacing clutch never contained more than the number of eggs necessary to complete the lost clutch, that is to say the two clutches together never contained more than 4 eggs. Therefore these clutches seem produced by the same ovarian cycle as the lost clutch. These supplemental clutches may therefore be added to those judged completed, even if they, in their turn, have disappeared before this can be confirmed by the subsequent behaviour of the parents. In the light of this added consideration we have in Table 1 divided clutches containing less than 4 eggs into those judged incomplete and those judged complete.

TABLE 1

| | incomplete clutches | | | completed clutches | | | | |
|---|---|---|---|---|---|---|---|---|
| | *c*/1 | *c*/2 | *c*/3 | *c*/1 | *c*/2 | *c*/3 | *c*/4 | |
| No. clutches .. | 3 | 3 | 2 | 1 | 3 | 5 | 19 | 36 |
| No. eggs lost .. | 1 | 4 | 6 | 1 | 4 | 8 | 28 | 52 |
| No. taken by predators .. | | 2 | | | | | 5 | 7 |
| No. found broken .. | 1 | | | | | 2 | 1 | 4 |
| No. deserted .. | 1 | | | | | | 7 | 8 |
| No. hatched .. | 0 | 0 | 0 | 0 | 2 | 5 | 35 | 42 |
| No. flying .. | | | | | 1 | 2 | 11 | 14 |
| | | | | | | | | (113) |

As Table 1 reveals the majority of eggs simply disappear. However, we have seen 7 eggs taken by predators or being eaten by them close to the nest. These were a snake *Zamenis* sp. and the two common crows *Corvus macrorhynchos* Wagler and *C. splendens* Vieillot. We suspect there may be other predators, especially during the night. We have also found vestiges of at least 5 broken eggs suggesting the crumbs left by marauders. Eight eggs were found deserted in the nest, or it was judged that this would have happened if they had not been collected earlier. The deserted egg classed as belonging to an incomplete clutch represents the one uncertain classification. This, the only egg of family 18, and found on 6/ii might not be the first egg of an incomplete clutch but an addled egg of a clutch of which others had hatched just before it was discovered, but, if so, this egg must have been laid about 5/i, i.e. 15 days earlier than an egg has yet been found.

When comparing the hatchability of the different sized clutches, it is necessary to omit the 15 incomplete clutches, for these were incomplete precisely because they were lost before they were completed.

There is then no significant difference between the hatching success of 2, 3 or 4 egg clutches.

On three occasions a fresh clutch was laid after the previous one had hatched. The intervals between the last hatch and first egg of the subsequent clutch were 35, 40 and 62 days. During the two shorter intervals the parents were leading the chicks of the first clutch, but during the longest intervals these must have died about 40 days before the new eggs were found. This long functionless delay was made by the same pair who delayed 34 days after a completed clutch had disappeared before starting a new one (Table 2). This was pair 17

TABLE 2

| | | *c*/**4** | *c*/3 | *c*/**2** | *c*/**2** |
|---|---|---|---|---|---|
| | *c*/**4** | $\overline{\underline{8}}$ $\overline{\underline{(7)}}$ $\overline{\underline{14}}$ | $\underline{(34)}$ $\overline{\underline{9}}$ | | |
| Replacement clutch | *c*/3 | | $\overline{\underline{8}}$ | | |
| | *c*/1 | $\overline{9}$ | (3) | 2 | |

explanation in text.

who, in 1966, occupied the territory which included our own garden. It was therefore entirely available for supervision, so these two delays cannot be explained away by assuming that clutches had been missed.

On one occasion (in 1964 by pair 3—see *b*), young were reared from two clutches during the same season. This has been recorded for *armatus* (Hall 1964) but is assumed never to occur in *vanellus*, thus simplifying demographic calculations (Lack 1954).

On only three occasions have eggs been laid in a scrape not newly made during the previous few days : in 1964 when those of pair 7 (perhaps pair 4), *c*/4 was found on 13/5 in the scrape from which the eggs of pair 4 had been found missing on 19/ii (*b*) ; in 1965 when pair 13 laid on 4/iv in a scrape first recorded on 25/ii after having laid and lost one clutch elsewhere in the intervening period ; and when pair 10 laid an egg on 12/vi in the same scrape from which an incomplete *c*/3 had been lost on 9/vi.

In 1966, 7 eggs were marked with Indian ink. Only 2 hatched, being laid on 26/iv and 28/iv, and hatching on 25/v and 26/v respectively.

Adding these to the 17 other eggs which have hatched in clutches of which we are sure of the laying date of all the eggs and assuming that eggs in a clutch hatch in the order they were laid :

| | | | | |
|---|---|---|---|---|
| 2 | have hatched | in | 30 | days |
| 6 | ,, ,, | ,, | 29 | ,, |
| 6 | ,, ,, | ,, | 28 | ,, |
| 5 | ,, ,, | ,, | 27 | ,, |

All 4 eggs have hatched in 5 clutches ; the interval between the hatching of the first chick and the removal of the last egg shell was, for pair 1, 23 hours 10 min. (*b*) ; the interval between the day of first finding a chick (often more than 1) and the nest emptying was, for four nests (2, 7, 11 and 13′) 1 day, and for one (5) 2 days. However, 3 days intervened between the first and the last hatch of the 3 surviving eggs of clutch 6′. These intervals are less than the 4 days between the 1st and 4th lay, confirming *b* that some synchronisation of hatching exists. We have also confirmed that this synchronisation is not achieved by delaying incubation, as it seems to be by species in colder habitats.

On three occasions we have found eggs outside their scrapes. On two they were found returned next day but in each scrape the appropriate number of eggs failed to hatch and were abandoned in the nest suggesting they had been killed by exposure. The third egg was collected, and after unsuccessful incubation an embryo was found in it at the developmental stage to be expected on this hypothesis. All these further data confirm our previous observation (*a* and *b*) that the environmental temperatures demand that the parents shade the eggs and sometimes cool them in other ways.

Table 1 also shows the hatching and flying success in the 3 breeding seasons 1964-66. The proportion of all eggs which hatched was $\frac{42}{114}$ (or 37%) and the proportion of completed clutches $\frac{42}{99}$ (or 42%). Only 14 (33%) of these chicks are known to have flown. The overall breeding success is thus either 12% or 14%.

Table 3 includes the same data arranged according to years. Fourteen young were therefore produced in the three seasons 1964-66 pair-seasons, and the breeding success seems to be declining. This is emphasised, and perhaps explained, by other data presented in this table. In 1964 some members of the first and last clutches that were found hatched. In 1965, 27 days elapsed between the discovery of the first egg and the laying of the first clutch that was successful. This clutch was the 5th found. Similarly 3 clutches during 20 days were found after the last that was even partially successful. These 2 intervals have become even greater in the 1966 season, as have the proportion of incomplete to completed clutches. Three of these incomplete clutches in 1966 and the extension of the laying season were due to pair 17 who

TABLE 3

| | No. pairs | No. clutches | No. eggs | Date of 1st of season | laying of hatching 1st | clutches last | last of season | No. hatched | No. flying | chick last seen |
|---|---|---|---|---|---|---|---|---|---|---|
| *malabaricus* | | | | | | | | | | |
| 1963 | 2 | 2 | 8 | | | | | 8 | 2 | |
| 1964 | 5 | 7 | 28 | 8/ii | 8/ii | 25/v | 25/v | 15 | 5 | 22/vii |
| 1965 | 9 | 19 (4) | 56 | 20/i | 16/ii | 13/v | 12/vi | 15 | 7 | 26/vii |
| 1966 | 6 | 10 (4) | 29 | 2/ii | 10/iii | 29/iv | 26/vi | 12 | 2 | 17/vi |
| | | | (113) | | | | | | | |
| *indicus* | | | | | | | | | | |
| 1966 | 1 | | 3 | 8/vi | — | — | 13/vi | | | |

incomplete clutches in brackets.

produced 5 clutches, and have previously been discussed because of inexplicable delays in producing fresh clutches.

The two clutches watched in 1963 are included in this table. They were doubtless selected for breeding success.

TABLE 4

| month | .. | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|---|
| No. incomplete clutches | .. | 1 | 2 | 1 | 1 | — | 3 | |
| No. eggs | .. | 6 | 23 | 29 | 25 | 19 | 11 | (113) |
| Average size clutch | .. | 2·0 | 3·3 | 3·2 | 3·6 | 3·8 | 2·2 | |
| % hatch | .. | 0 | 22 | 62 | 36 | 42 | 0 | |
| % flying | .. | — | 17 | 14 | 16 | 11 | — | |

Table 4 shows the laying-hatching-flying data arranged by calendar months. There are probable errors in this table due to the convention adopted that if a clutch is neither seen laid nor hatched it is included in the month it was discovered, whereas if a clutch hatched we are then reasonably certain that it was laid 27-30 days before. From the table it appears that eggs laid in March have the best chance of success. This peak would be even more pronounced if the eight 1963 eggs, all laid in March, were included.

## INCURSION OF *V. indicus*

The redwattled lapwing *V. indicus* is usually discussed and compared with *malabaricus*, and they have been again reunited in the genus *Vanellus*.

They provide an excellent demonstration of the rule that two closely related species will possess different ecological requirements. Table 5 gives extracts from six authorities. It is interesting how they disagree in detail, and also with some of our previous statements in the present paper. However, there is complete agreement that *indicus* is a species of damper, and more cultivated land, than *malabaricus*. This ecological difference is quite obvious in and around Bhubaneswar. We agree with Ali (1961) concerning *indicus* being found in forest glades but we disagree with this implication that it is not found in larger groups than 2. Flocks of the 2 species have been seen feeding together, but keeping separate. However, here *indicus* is often found nesting in dry paddy fields, where what are obviously breeding pairs are conspicuous throughout the dry weather. All nests found by us, previous to 1966, were found in such terrain. The nest described by Naik *et al.* (1961) in western India was also in such a field.

However, in 1966, on 5/vi (the monsoon having started on 28/v) a pair were seen on the typical rocky waste ground just behind the

TABLE 5

| *malabaricus* | *indicus* | authority |
|---|---|---|
| 'dry stony plains, open sandy downs, and arable land, often very far from water ;' | 'generally found not far from water, though now and then at a considerable distance'. | Jerdon III 1864 |
| 'the [nest] site is always one in open country, fields, barren land, semi-desert or even ploughed fields but, preferably not far from water'.<br><br>'This Lapwing keeps much to dry and open land——— The vicinity of water does not seem a necessity and it seldom or never haunts the beds of streams like the Red-wattled and Spur-winged Plovers so often do'. | 'the most common [nest] site is, perhaps, on shingle- and sand-beds in rivers. Often, however, they lay at a considerable distance from water in waste land, fallow or ploughed fields ——' | Baker VI 1929 |
| 'Found in dry open country but not true desert' ———<br><br>'a bird of dry and open country where it is found on waste land and ploughed fields — — — — — — — Unlike the Red-wattled Lapwing it avoids the neighbourhood of water, ——— 'a ploughed field affords a favourite situation (for the nest)'. | 'avoids both purely desert country and thick forest ——— Though it prefers open cultivation and the outskirts of tanks and jheels'<br><br>'The nest is placed on the ground in almost any open ground provided that water is reasonably near'. | Whistler 4th ed. 1949 |
| 'Unlike the Red-wattled Lapwing, it likes very dry conditions being found in arid waste-land, fallow fields, stony pastures and the like'. | 'Its favourite haunts are the grassy borders of tanks, fallow paddy fields and, in general, any flat ground near water'. | Henry 1955 |
| 'Pairs, or small parties, on dry waste land'.<br>'Inhabits dry open country and fallow land, and is less dependent upon the neighbourhood of water than [*V. indicus*]'. | 'Scattered pairs at tanks, puddles etc.' 'Affects open country, ploughed fields, grazing land, and margins and dry beds of tanks and puddles. Also met with in forest glades around rain-filled depressions'. | Ali, 6th ed. 1961 |
| 'in open dry areas usually near marshes, abandoned paddy, or semi-cultivation'. | 'near rivers, semi-cultivation and swamps'. | Ripley 1961 |

house (see map in *b*). On 8/vi the scrape and one egg (Plate II, Fig. 4) were found in the area WNW of the road at the top of that map. A pair was seen near the scrape, but observations were made during the late afternoon when incubation could not be expected. The second egg was first seen on 11/vi and the 3rd on 13/vi. On 12/vi, and on 15/vi in the morning no birds were seen attending the nest, but one was present in the evening of the latter day. Therefore incubation did not seem to have begun. On 16/vi afternoon the eggs were found destroyed, egg-shell being scattered around up to 8 m. away. Small stones were piled in the nest and a small pit 15 cm. deep and 15 cm. diameter had been dug on its edge. Both birds came and screamed at the observers. They were seen on 17/vi, but then left the area.

Compared with the laying of *malabaricus* eggs this clutch took a long time, and we do not know if it was completed, in the sense used in this paper.

These dates are late in the season, and typical of ' pioneers ', i.e., birds which have failed to establish, or maintain themselves, in an area of their more usual ecological niche, and make a belated attempt in a suboptimal marginal environment.

From the quotations listed in Table 5, it could be suggested that the preference of *indicus* for ploughed land implies a greater tolerance (especially as Baker and Whistler both note a preference to the ballast of the railway lines) than *malabaricus* for human nearness. Perhaps humans even provide some more positive attraction for *indicus*. The human activity on this study area has been steadily increasing since 1963, but only in respect of building and the making and use of *kutcha* roads. This land has not been ploughed nor has any increased water supply been made. We make this suggestion but knowing the species and the terrains we are sceptical of it. The *indicus* pair observed nested in the most undisturbed part of the study area. Almost all paddy fields during the dry months, February to May, are less visited by humans than either the gardens in which birds are continually disturbed by the gardeners, or the waste land that is used as a short cut across a State Capital, both of which are chosen by *malabaricus*.

## Discussion

The conclusions of our earlier papers have not been overturned, but some changes are appearing in the population.

Is this species breeding successfully—however-success is defined? Fortunately a recent review of mortality and fertility in birds of this group has appeared (Boyd 1962). On immediate reading of this, after the first draft of this paper was completed, our impression is how little we have to offer for comparison. And one point may not have been sufficiently

emphasised. Many, perhaps most, European workers consider that they study a more or less discrete breeding colony of their chosen species of charadriid. These are not judged to be *isolates* in the genetical sense, but it is considered worthwhile to consider, and if possible to measure, both the return of young to them, and also other immigration. Our population of *malabaricus* is defined by its study area, which is determined by *human considerations*, mainly the area which can be surveyed critically from the roof of our single storied house, but this is complicated by both the screening value of the vegetation in the various neighbouring gardens, and by whether these are for public or private reasons available for us to examine on the ground. Uninterrupted, and known to be exploited, *malabaricus* habitat extends towards the north and west. There are more territories to the north-east and east of our waste land than we are able to survey, and in all directions throughout the new and old cities, *malabaricus* pairs are known to breed.

Returning to the comparison with Boyd's data, we know nothing of the mortalities, including the several important subdivisions of these, which have been obtained by ringing data. However, our tables provide three of his parameters for the estimate of fertility. (Unfortunately three are insufficient for the estimate). Over the 3 years 1964-66, Boyd's $c$, the mean number of eggs laid per female per year, has been $\frac{113}{20}$ or 5·65, which is within Boyd's range for Palaearctic species and well below the maximum for *V. vanellus* itself, i.e. though verbal description suggests that the performance by *malabaricus* for clutch replacement is greater than for Palaearctic species, this is not borne out by the figures. For *malabaricus*, Boyd's $u$, the fraction of eggs laid which hatch, is $\frac{42}{113}$ or 0·37. Only one value for $u$ given in Boyd's table is lower than this. Boyd's $v$, the fraction of hatched young which fly, is, for *malabaricus*, $\frac{14}{42}$ or 0·33 which is a value lower than any Boyd has recorded. We have no idea of the other relevant parameters, namely the age at first breeding, and the mortality before this.

However, breeding success has altered from year to year. Though from the two criteria of the number of pairs recorded in the area (which is a maximum, and we do not know how critical), and the number of chicks flying, the most successful year was 1965, this was achieved at the expense of a much greater waste of eggs than in 1964. This wastage was probably the cause of the extension in time of the egg laying period. When the monsoon broke, there were still pairs who had not yet raised a clutch or had raised only one, and that several months before. It is easy to suggest that these late clutches have a poor prognosis for hatching because they are laid in suboptimal ecological conditions, the terrain being damp. Also the delay between the laying of the first egg and the laying of the first successful egg can be explained similarly. At this time, which is winter and comparatively cold, it is probable that alternative food supply for various predators is rarer than later in the season.

The period between the first clutch and the first successful clutch, and that between the last successful clutch and the last clutch were both increased in 1966, which also, by the other criteria, was less successful than previous years.

Thus it seems that the study area is deteriorating for yellow-wattled lapwings. Whether this is correlated with the arrival in the area, very late in the season, of one pair of the ecologically different closely related redwattled lapwing is unknown.

The obvious explanation of this deterioration, but not necessarily the correct one, is the increasing human activity in the area. This is both *activity*, gangs collecting stones, building roads and culverts, and people going to and from their places of work, and also the *destruction of the habitat* by building, but more the former than the latter.

## Summary

A maximum of 22 pair-seasons of *Vanellus malabaricus* have been observed in the not yet built upon ground in the centre of Unit 5 Bhubaneswar New Capital and the adjacent approaches to the Raj Bhavan of Orissa. The activity of this species continues to be conspicuous, but the breeding success during the years 1964 to '66, suggests that the environment is deteriorating. *V. indicus* entered the area for the first time, late and ineffectually, in 1966.

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# Flora of the Bhillangna Valley of the erstwhile Tehri-Garhwal State

BY

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This paper gives an account of a collection of plants from the Bhillangna Valley of Tehri-Garhwal, made during the years 1963 to 1965 during which nearly 1400 specimens of 410 species were collected. The area covered by this study includes river valleys, glacier beds, mountain slopes and meadows ranging in altitude between 600 and 4200 metres.

## INTRODUCTION

The Bhillangna Valley derives its name from the Bhillangna River which runs through the entire length of the valley. The Bhillangna River originates from Khatling Glacier, is fed in its course by Kshirganga near Mahsar Tal and Balganga at Baunr, and finally meets the Bhagirathi River at Tehri. Tehri-Garhwal, of which the Bhillangna Valley is a part, lies entirely within the Himalayan ranges between 30° 20-30°50 N, and 78°35-78°55 E and covers an area of about 1000 sq. miles. It is surrounded by Ramain and Bashahr in the north, Tibet in the east, Pauri Garhwal in the south and Dehra Dun in the west. The region consists of a series of ridges separated by narrow valleys running north-east to south-west, and radiating from the lofty peaks bordering Tibet.

Burrard & Hayden (1907) divided the Himalayas into three zones; the greater Himalayas, the lesser Himalayas and the Siwaliks. The area selected for exploration lies in the former two zones. The Greater Himalayan ranges are composed of granite and crystalline rocks and are characterized by the presence of snowy peaks, the average height of which exceeds 6500 m. The lesser Himalayan ranges are made of sedimentary rocks such as slate, quartzite, conglomerate and limestone and their altitude ranges between 1800 m. and 3000 m.

From climatic point of view the Bhillangna Valley can be divided into three zones similar to Hooker's three climatic zones of Western Himalayas.

1. *Tropical Zone :* Extends up to an altitude of 1500 m., the lower limit of snow-fall during winter. Annual rainfall 203 to 228 cm. The

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temperature rarely falls below freezing point, and in May it rises to 40·56°C or above. The monsoon starts about the middle of June and lasts up to the end of September. Mist increases the humidity to saturation point. In autumn due to continuous sunshine the humidity decreases. Spring is the hottest season of the year.

2. *Temperate Zone :* Extends from 1500 m. to 3600 m. the upper limit of trees. Here the temperature is lower and precipitation less with considerable portion of it received as snow. The annual precipitation falls as rain. Autumn is characterized by sunshine and low humidity. During winter the temperature falls below—11·11°C. In spring the temperature rises and the humidity is very low.

3. *Alpine Zone :* The alpine zone is above 3600 m. Here winters are cold and growing season for plants is short. Spring and autumn seasons are practically eliminated. Precipitation is very small and mostly in the form of snow. Winters are characterized by heavy snow-fall. This zone is characterized by large spreading meadows.

Recently R. K. Gupta (1956) gave a brief description of the flora of Tehri-Garhwal. In Bhillangna Valley he confined his studies to Mahsar Tal, Sashsar Tal, Chandrabadni and Ghansali, from where he described about 250 plant species. A greater part of the valley, however, remained unexplored.

This paper presents a fairly comprehensive account of the flora of Bhillangna Valley. An extensive exploration of the valley was undertaken by the authors during 1963, 1964 and 1965 during the months of March, April, May, June, July, August, September and October. Eighteen localities situated in river valleys, glacier beds, mountain slopes and meadows, scattered over an area of about 680 sq. miles, were covered during the course of study. Most of the area was covered on foot. There is a motor road from Tehri to Ghansali. From Ghansali onwards there are no proper means of communication and therefore the whole journey from Ghansali to Ghuttu, and from Ghuttu to Rupagali (Ponwali route), and from Ghuttu to Kalayani (Mahsar route) was performed on foot. On the Ponwali route, Gawana (2100 m.) was the last village. On the Mahsar Tal route, Gangi (2700 m.) was the last inhabited spot above which we came across large meadows. In Gangi people live on *phapru* (*Fagopyrum esculentum*), *alu* (*Solanum tuberosum*), *marcha* (*Amaranthus paniculatus*) and their chief domestic animals are goats, rarely cattle. Being a country of widely varying topography a large variety of plants of different climatic zones were collected. At altitudes above 3000 metres snow covered peaks were a common feature and alpine herbs like species of *Caltha*, *Potentilla*, *Primula* and dwarf *Rhododendron* were blooming. The valley is important from the point of view

of medicinal plants. About 20 species of medicinal plants are exported from here to the markets of Hardwar, Dehra Dun and Delhi. In recent years the importance of the valley has further increased due to its suitability for the cultivation of medicinal plants. Sandoz Ltd. selected Matia, near Ponwali (3240 m.) for the cultivation of an important species of medicinal plant, *Podophyllum hexandrum* from which Podophyllin, an alleged cure for cancer, is obtained. Ponwali and Matia have been considered suitable for the cultivation of another important medicinal plant, *Nardostachys jatamansi*.

410 species of plants belonging to 90 families were collected during the study. The Table gives a summary of the collections made.

TABLE

| | Families | Genera | Species |
|---|---|---|---|
| Dicotyledons .. | 79 | 276 | 362 |
| Monocotyledons .. | 8 | 31 | 41 |
| Gymnosperms .. | 3 | 5 | 7 |

In the detailed enumeration the following procedure has been adopted. To facilitate easy reference the order of the families of flowering plants is the same as in Hooker's FLORA OF BRITISH INDIA (1872-97). Every effort has been made to bring the nomenclature up-to-date. All the specimens included in the list are preserved in the herbarium of the Survey of Medicinal Plants Unit, Gurukula Kangri Vishwavidyalaya, Dist. Saharanpur. Brief mention is made of the locality and altitude of occurrence of each species.

## LIST OF PLANTS COLLECTED DURING 1963-65

### RANUNCULACEAE

**Aconitum falconeri** Stapf
Ponwali, Rajkhark, 3000-3600 m.; *Uniyal* 3134 & 3602.

**A. heterophyllum** Wall.
Ponwali 3000 m.; *Uniyal* 1646, 1490 & 3601.

**A. laeve** Royle
Ponwali 3300 m.; *Dey* 1265.

**Aquilegia pubiflora** Wall. ex Royle
Gangi 2700 m.; *Uniyal* 781 & 3851.

**Caltha palustris** Linn.
Ponwali 2700 m.; *Uniyal* 898, 665 & 1240.

**Clematis buchananiana** DC.
Ghuttu 2100 m.; *Uniyal* 1680.

**C. barbellata** Edgew.
Ponwali 3300 m. ; *Saxena* 895.

**C. nepaulensis** DC.
Ponwali 2800 m. ; *Saxena* 1253.

**Delphinium denudatum** Wall. ex Hook.
Indrola 1200 m. ; *Uniyal* 704.

**D. vestitum** Wall. ex Royle
Tali 3300 m. ; *Uniyal* 605.

**Paeonia emodi** Wall.
Margaon 2100 m. ; *Uniyal & Saxena* 1208.

**Ranunculus hirtellus** Royle
Ponwali 2800 m. ; *Uniyal* 1213.

**R. laetus** Wall.
Ghuttu 1600 m. ; *Dey* 1206.

**Thalictrum alpinum** Linn.
Tali 3600 m. ; *Uniyal* 882.

**T. javanicum** Bl.
Ponwali 3300 m. ; *Uniyal* 1487.

**T. foliolosum** DC.
Alaknanda Range 2400 m. ; *Uniyal* 3600.

**T. reniforme** Wall.
Ponwali 2800 m. ; *Uniyal* 3672.

### MAGNOLIACEAE

**Michelia champaca** Linn.
Cultivated at Ghuttu 900 m. ; *Dey* 1321.

**Schizandra grandiflora** Hook. f. & Th.
Ghuttu 2700 m. ; *Uniyal* 1098.

### MENISPERMACEAE

**Cissampelos pareira** Linn.
Indrola 900 m. ; *Uniyal* 3335.

**Cocculus laurifolius** DC.
Ghansali 900 m. ; *Uniyal* 3358.

**Stephania glabra** Miers.
Ghansali 900 m. ; *Uniyal* 721.

### BERBERIDACEAE

**Berberis asiatica** Roxb.
Ghuttu 1800 m. ; *Saxena* 486.

**B. chitria** Lindl.
Mataya 2700 m. ; *Uniyal* 441.

**B. coriaria** Brand.
Ponwali 2800 m. ; *Uniyal* 683.

**B. lycium** Royle
Ghansali 900 m. ; *Uniyal* 576.

**Podophyllum hexandrum** Royle
Ponwali and Rajkhark 3000 m. ; *Uniyal* 1097 & 3832.

### Papaveraceae

**Meconopsis aculeata** Royle
The Himalayan blue poppy, at Tali 3600 m. : *Uniyal* 3122.

### Fumariaceae

**Corydalis govaniana** Wall.
Ponwali 3000 m. ; *Uniyal* 3326.

**C. ramosa** Wall. ex Hook. f.
Mataya 2800 m. ; *Uniyal* 1774.

**C. cornuta** Royle
Ponwali 2800 m. ; *Uniyal* 3440.

**Fumaria indica** Pugsley
Chamba 1600 m. ; *Uniyal* 493.

### Violaceae

**Viola biflora** Linn.
Gangi-Kalayani 2400 m. ; *Saxena* 1183.

**V. serpens** Wall.
Ghuttu 1800 m. ; *Uniyal* 681.

### Cruciferae

**Barbarea vulgaris** Br.
Tali-Rajkhark 3300 m. ; *Uniyal* 816.

**Capsella bursa-pastoris** Medic.
Ponwali 3000 m. ; *Uniyal* 1360.

**Cardamine impatiens** Linn.
Ghuttu 2400 m. ; *Saxena* 797.

**Erysimum hieracifolium** Linn.
Kalayani 2700 m. ; *Uniyal* 1335.

**Eutrema primulaefolium** Hook. f. & Th.
Tali 3600 m. ; *Uniyal* 1277.

**Megacarpaea polyandra** Benth.
Tali 3600 m. ; *Uniyal* 864.

### Flacourtiaceae

**Flacourtia indica** Merr.
Ghonti 900 m. ; *Uniyal* 3655.

### Polygalaceae

**Polygala abyssinica** R. Br.
Chamba 1600 m. ; *Dey* 1048.

**P. chinensis** Linn.
Ghansali 900 m. ; *Uniyal* 1604.

**P. crotalariodes** Buch.-Ham.
Gangi 2100 m. ; *Saxena* 798.

**P. persicariaefolia** DC.
Ghansali 900 m. ; *Uniyal* 1605.

## CARYOPHYLLACEAE

**Sagina procumbens** Linn.
Mataya 2100 m. ; *Uniyal* 3890.

**Silene griffithii** Boiss.
Mataya 2700 m. ; *Saxena* 1378.

**S. inflata** Benth.
Duphand 2100 m. ; *Uniyal* 3436.

**S. venosa** Aschers.
Gangi 2700 m. ; *Uniyal* 1450.

**Stellaria decumbens** Edgew.
Tali 3600 m. ; *Saxena* 1287.

**S. latifolia** Benth.
Duphand 2100 m. ; *Uniyal* 639.

**S. media** Linn.
Mataya 2400 m. ; *Uniyal & Dey* 1226.

## HYPERICACEAE

**Hypericum dyeri** Rehder.
Duphand 2100 m. ; *Saxena* 1336.

**H. elodeoides** Choisy.
Ponwali 3300 m. ; *Uniyal* 1491.

**H. hookerianum** Wall.
Ponwali 3000 m. ; *Uniyal* 3310.

**H. oblongifolium** Choisy.
Chamba 1600 m. ; *Uniyal* 551.

**H. perforatum** Linn.
Banchuri 1600 m. ; *Uniyal* 717.

## MALVACEAE

**Abutilon graveolens** Wt. & Arn.
Tehri 700 m. ; *Uniyal* 3690.

**Hibiscus cannabinus** Linn.
Ghuttu 1200 m. ; *Dey* 1327.

**Sida cordifolia** Linn.
Ghuttu 1000 m. ; *Uniyal* 3664.

**S. veronicaefolia** Lamk.
Ghuttu 1200 m. ; *Dey* 1327.

## TILIACEAE

**Grewia sapida** Roxb.
Ghansali 900 m. ; *Uniyal* 751.

## LINACEAE

**Reinwardtia indica** Dum.
Banchuri 1600 m. ; *Uniyal* 3883.

### GERANIACEAE

**Geranium ocellatum** Camb.
Ghansali 900 m. ; *Uniyal* 583.

**G. wallichianum** Sweet
Mataya 2100 m. ; *Uniyal* 3884.

### BALSAMINACEAE

**Impatiens cristata** Wall.
Ponwali 3300 m. ; *Saxena* 1104.

**I. macrophylla** Gaertn.
Ponwali 3300 m. ; *Saxena* 1104.

**Oxalis acetosella** Linn.
Mataya 2400 m. ; *Uniyal* 1259.

### RUTACEAE

**Aegle marmelos** Corr.
Ghonti 950 m. ; *Uniyal* 3885.

**Murraya paniculata** Jack.
Ghansali 900 m. ; *Saxena* 738.

**Skimmia laureola** Sieb. & Zucc.
Ponwali 2800 m. ; *Uniyal* 678.

**Toddalia aculeata** Pers.
Ghansali 900 m. ; *Uniyal* 735.

**Zanthoxylum alatum** Roxb.
Ghansali 900 m. ; *Uniyal* 575.

### AQUIFOLIACEAE

**Ilex dipyrena** Wall.
Gaja 1200 m. ; *Uniyal* 550.

### CELASTRACEAE

**Celastrus paniculata** Willd.
Banchuri 1200 m. ; *Uniyal* 708 or 3628.

**Euonymus hamiltonianus** Wall.
Duphand 2700 m. ; *Uniyal* 686.

**E. pendulus** Wall.
Saord 2100 m. ; *Uniyal* 715.

**E. tingens** Wall.
Duphand 2100 m. ; *Dey* 1209.

### RHAMNACEAE

**Helinus lanceolatus** Brand.
Duphand 2700 m. ; *Uniyal* 663.

**Rhamnus purpurea** Edgew.
Ponwali 3000 m. ; *Uniyal* 888.

**R. triqueter** Wall.
Ghuttu 1200 m. ; *Uniyal* 1320.

**R. variegatus** Roxb.
Indrola 900 m. ; *Uniyal* 707.

## VITACEAE

**Leea edgeworthii** Santapau
Ghansali 900 m. ; *Uniyal* 751.

**Vitis lanata** Roxb.
Duphand 2700 m. ; *Uniyal* 1309.

## ACERACEAE

(Sapindaceae)

**Acer caesium** Wall. ex Brandis
Duphand 2700 m. ; *Uniyal* 1309.

## HIPPOCASTINACEAE

(Sapindaceae)

**Aesculus indica** Colebr.
Gangi 2400 m. ; *Uniyal* 790.

**Cardiospermum halicacabum** Linn.
Indrola 900 m. ; *Uniyal* 3644.

## STAPHYLEACEAE

(Sapindaceae)

**Staphylea emodi** Wall. ex Brandis
Gangi 2400 m. ; *Uniyal* 825.

## ANACARDIACEAE

**Lannea coromandelica** (Houtt.) Merr.
Ghansali 900 m. ; *Uniyal* 755.

**Pistacia integerrima** Stew.
Ghonti 900 m. ; *Uniyal* 446 & 3625.

**Rhus cotinus** Linn.
Ghansali 900 m. ; *Uniyal* 577.

**R. parviflora** Roxb.
Tehri 600 m. ; *Uniyal* 422.

**R. wallichii** Hook. f.
Ghansali 900 m. ; *Uniyal* 1642 & 1335.

## CORIARIACEAE

**Coriaria nepalensis** Wall.
Banchuri 1600 m. ; *Uniyal* 1723.

## Caesalpinaceae

**Bauhinia vahlii** W. & A.
Ghansali 900 m. ; *Dey* 1376.

**Caesalpinia sepiaria** Roxb.
Ghansali 900 m. ; *Uniyal* 721.

**Cassia leschenaultii** Wall.
Ghuttu 1500 m. ; *Saxena* 1141.

**C. laevigata** Willd.
Ghansali 900 m. ; *Uniyal* 761.

## Papilionaceae

**Atylosia scarabaeoides** Benth.
Ghuttu 1300 m. ; *Uniyal* 1079.

**Crotalaria albida** Heyne ex Roth.
Ghuttu 1500 m. ; *Uniyal* 641.

**Desmodium microphyllum** (Thunb.) DC.
Ghuttu 1200 m. ; *Saxena* 778.

**Lathyrus luteus** Baker
Gangi 2400 m. ; *Uniyal* 1161.

**Lespedeza stenocarpa** Maxim.
Ghansali 900 m. ; *Saxena* 1062.

**Lotus corniculatus** Linn.
Gangi 2700 m. ; *Saxena* 858.

**Indigofera gerardiana** Wall.
Ghonti 900 m. ; *Uniyal* 707.

**I. dosua** Buch.-Ham.
Ponwali 3000 m. ; *Uniyal* 3867.

**Thermopsis barbata** Royle
Tali 3600 m. ; *Saxena* 827.

**Trigonella gracilis** Benth.
Tali 3600 m. ; *Uniyal* 876.

**T. emodi** Benth.
Ponwali 3000 m. ; *Uniyal* 3306.

**Piptanthus nepalensis** D. Don
Mataya 2800 m. ; *Uniyal* 3103.

**Uraria neglecta** Prain
Ghansali 900 m. ; *Uniyal* 2079.

**U. picta** Desv.
Ghansali 900 m. ; *Uniyal* 786.

**Vicia tenera** Grah.
Gaja 2100 m. ; *Uniyal* 598.

## Rosaceae

**Agrimonia eupatorium** Linn.
Gangi 2400 m. ; *Saxena* 847.

**Cotoneaster obtusa** Wall. ex Lindl.
Maghu 3300 m. ; *Uniyal* 685.

**C. bacillaris** Wall.
Duphand 2400 m.; *Uniyal* 3398.

**Deutzia staminea** R. Br.
Ghansali 900 m. ; *Uniyal* 580.

**Fragaria vesca** Linn.
Ponwali 2700 m. ; *Saxena* 1221.

**Geum elatum** Wall.
Tali 3600 m. ; *Uniyal* 874.

**G. urbanum** Linn.
Kalayani 2400 m. ; *Saxena* 1188.

**Potentilla kleiniana** Wt. & Arn.
Poibagi 2100 m. ; *Dey* 1121.

**P. sibbaldi** Wall.
Ponwali 1700 m. ; *Saxena* 1224.

**P. microphylla** D. Don
Tali 3600 m. ; *Saxena* 869.

**P. gerardiana** Lindl.
Ponwali 2700 m. ; *Uniyal* 1303.

**P. atrosanguinea** Lodd.
Tali 3600 m. ; *Uniyal* 878.

**P. fulgens** Wall.
Poibagi 2100 m. ; *Uniyal* 3452.

**Prunus cerasoides** D. Don
Ghuttu 1500 m. ; *Dey* 1119.

**Prunus cornuta** Wall.
Mataya 2700 m. ; *Dey* 1111.

**P. padus** Linn.
Ponwali 2700 m. ; *Saxena* 1248.

**Pyrus pashia** Buch.-Ham.
Ghonti 900 m. ; *Uniyal* 647.

**P. lanata** D. Don
Poibagi 2700 m. ; *Uniyal & Saxena* 1237.

**Rubus niveus** Thunb.
Ghansali 900 m. ; *Uniyal* 578.

**R. ellipticus** Sm.
Ghansali 900 m. ; *Uniyal* 576.

**R. paniculatus** Sm.
Poibagi 2700 m. ; *Uniyal* 1236.

**Rosa sericea** Lindl.
Poibagi 2700 m. ; *Uniyal* 687.

**R. moschata** Mill.
Ghansali 900 m. ; *Uniyal* 584.

**Sorbus foliolosa** (Wall.) Spach.
Poibagi 2400 m. ; *Saxena* 1251.

**Spiraea bella** Sims.
Gangi 2400 m. ; *Uniyal* 813.

**S. vestita** Wall.
Poibagi 2400 m. ; *Uniyal* 1446.

### Saxifragaceae

**Bergenia ciliata** (Roxb.) Raizada
Poibagi 2400 m. ; *Uniyal* 1683.

**B. ligulata** Engl.
Maghu 2700 m. ; *Uniyal* 674.

**B. stracheyi** Engl.
Rupagali 3800 m. ; *Uniyal* 1670 & 3847.

**Deutzia straminea** R. Br.
Ghuttu 1500 m. ; *Dey* 1128.

**Hydrangea anomala** D. Don
Ponwali 3000 m. ; *Uniyal* 664.

**H. altissima** Wall.
Kalayani 2700 m. ; *Uniyal* 806.

**Parnassia nubicola** Wall. ex Royle
Mataya 2900 m. ; *Uniyal* 1502.

**Ribes alperstre** Wall. ex Decne
Khatlingh 3900 m. ; *Uniyal* 1425.

**Saxifraga diversifolia** Wall.
Tali 3600 m. ; *Uniyal* 1499.

### Crassulaceae

**Sedum trifidum** Linn.
Ponwali 3000 m. ; *Uniyal* 1509.

### Droseraceae

**Drosera lunata** Buch.-Ham.
Gangi 2400 m. ; *Saxena* 1150.

### Lythraceae

**Punica granatum** Linn.
Indrola 800 m. ; *Uniyal* 642.

**Woodfordia fructicosa** Kurz.
Ghansali 900 m. ; *Uniyal* 586.

### Onagraceae

**Hartmania rosea** G. Don
Banchuri 1500 m. ; *Uniyal* 620.

### Combretaceae

**Terminalia chebula** Retz.
Sarana 900 m. ; *Uniyal* 1322.

**T. belirica** Roxb.
Sarana 900 m. ; *Uniyal* 3886.

### Cucurbitaceae

**Bryonopsis laciniosa** (Linn.) Naud.
Ghonti 900 m. ; *Uniyal* 3624.

**Trichosanthes bracteata** (Lam.) Voigt.
Ghansali 900 m. ; *Uniyal* 1324.

### Umbelliferae

**Angelica glauca** Edgew.
Rajkhark 3300 m. ; *Uniyal* 3607.

**Bupleurum lanceolatum** Wall.
Gangi 2400 m. ; *Uniyal* 3421.

**B. maddeni** C.B.C.
Ponwali 2700 m. ; *Uniyal* 1439.

**Centella asiatica** (L.) Urb.
Ghonti 900 m. ; *Uniyal* 3170.

**Heracleum candicans** Wall.
Ghuttu 1500 m. ; *Uniyal* 623.

**Sanicula europaea** Linn.
Kalayani 2700 m. ; *Saxena* 1190.

**Selinum wallichianum** (DC.) Raizada & Saxena
Ponwali 3000 m. ; *Uniyal* 3114.

**S. vaginatum** Clarke
Tali 3600 m. ; *Uniyal* 3608.

**Trachelospermum falconeri** (Clarke) Wolff.
Ghuttu 1200 m. ; *Uniyal* 3818.

ARALIACEAE

**Hedera nepalensis** K. Koch.
Banchuri 1500 m. ; *Uniyal* 2010.

**Pentapanax parasiticum** Seem.
Poibagi 2100 m. ; *Uniyal* 1657.

**Schefflera venulosa** (W. & A.) Harms.
Ghansali 900 m. ; *Uniyal* 747.

CORNACEAE

**Cornus macrophylla** Wall.
Banchuri 1500 m. ; *Uniyal* 713.

CAPRIFOLIACEAE

**Lonicera angustifolia** Wall.
Poibagi 2400 m. ; *Dey* 1224.

**L. purpurascens** Hook. f. & Th.
Ponwali 3300 m. ; *Saxena* 1101.

**L. quinquelocularis** Hardw.
Gangi 2400 m. ; *Uniyal* 621.

**Viburnum cotinifolium** D. Don
Mataya 2800 m. ; *Saxena & Uniyal* 1130 & 1270.

**V. nervosum** D. Don
Rajkhark 3300 m. ; *Uniyal* 1276.

**V. mullaha** Buch.-Ham. ex Don
Ghuttu 1500 m. ; *Uniyal* 1662.

RUBIACEAE

**Hymenopogon parasiticum** Wall.
Poibagi 2100 m. ; *Uniyal* 1116.

**Pavetta tomentosa** Roxb. ex Sm.
Ghuttu 1500 m. ; *Uniyal* 1699.

**Randia dumetorum** (Retz) Lam.
Ghansali 900 m. ; *Uniyal* 1326.

**R. tetrasperma** Roxb.
Tehri 600 m. ; *Uniyal* 426.

**Rubia cordifolia** Linn.
Banchuri 1500 m. ; *Uniyal* 525.

**Uncaria pilosa** Roxb.
Ghuttu 1500 m. ; *Uniyal* 1137.

**Wendlandia exserta** DC.
Ghuttu 1500 m. ; *Uniyal* 555.

## Valerianaceae

**Nardostachys jatamansi** DC.
Tali 3600 m. ; *Uniyal* 1194.

**Valeriana pyrolaefolia** DC.
Maghu 3000 m. ; *Uniyal* 676.

**V. jatamansi** Jones
Ponwali 2700 m. ; *Uniyal* & *Saxena* 484 & 682.

## Dipsacaceae

**Dipsacus inermis** Wall.
Kanatal 2100 m. ; *Dey* 1553.

**Morina longifolia** Wall.
Ponwali 3000 m. ; *Uniyal* 1779.

## Compositae

**Ageratum conyzoides** Linn.
Ghansali 900 m. ; *Saxena* 769.

**Ainsliaea aptera** DC.
Ponwali 2700 m. ; *Uniyal* 1666.

**Aster asperulus** Nees
Poibagi 2100 m. ; *Uniyal* 1123.

**A. molliusculus** Wall.
Chamba 1200 m. ; *Uniyal* 726.

**Conyza stricta** Willd.
Ghonti 900 m. ; *Uniyal* 582.

**Cyathocline lyrata** Cass.
Poibagi 2100 m. ; *Dey* 1086.

**Dichrocephala chrysanthemifolia** DC.
Gangi 2100 m. ; *Saxena* 1157.

**D. latifolia** DC.
Poibagi 2100 m. ; *Uniyal* 1224.

**Gerbera kurzeana** Braum. & Asch.
Tali 3660 m. ; *Uniyal* 1268.

**G. lanuginosa** Benth.
Tehri 900 m. ; *Uniyal* 1234.

**Gnaphalium luteoalbum** Linn.
Poibagi 2400 m. ; *Uniyal* 1224.

**Inula cuspidata** Clarke
Ghonti 900 m. ; *Uniyal* 718.

**Saussurea albescens** Hook f. & Th.
Poibagi 2400 m. ; *Uniyal* 1665.

**S. obvallata** Wall.
Rupagali 4000 m. ; *Uniyal* 1489.

**S. roylei** C. B. Cl.
Ponwali 3300 m. ; *Uniyal* 1455.

**Senecio chrysanthemoides** DC.
Ponwali 2700 m. ; *Uniyal* 1201.

**S. nudicaulis** Buch.-Ham.
Ghansali 900 m. ; *Uniyal* 581.

**Sphaeranthus senegalensis** DC.
Ghansali 900 m. ; *Saxena* 730.

**Solidago virga-aurea** Linn.
Ponwali 3300 m. ; *Uniyal* 1506.

**Tanacetum longifolium** Wall.
Tali 3600 m. ; *Saxena* 1275.

**Taraxacum officinale** Wigg.
Ponwali 3000 m. ; *Uniyal* 1671.

**Tragopogon gracilis** D. Don
Gangi 2100 m. ; *Saxena* 1156.

**Vicoa indica** DC.
Ghansali 900 m. ; *Uniyal* 763.

## CAMPANULACEAE

**Campanula colorata** Wall.
Ghuttu 900 m. ; *Uniyal* 770.

**C. latifolia** Linn.
Ponwali 3000 m. ; *Uniyal* 1501.

**Cyananthus lobatus** Wall. ex Benth.
Ponwali 3000 m. ; *Uniyal* 1488.

## ERICACEAE

**Cassiope fastigiata** D. Don
Tali 3600 m. ; *Uniyal* 821.

**Gaultheria nummulariodes** D. Don
Mataya 2400 m. ; *Saxena* 1099.

**G. trichophylla** Royle
Mataya 2400 m. ; *Saxena* 1098.

**Lyonia ovalifolia** (Wall.) Drude.
Ghuttu 1800 m. ; *Uniyal* 1227.

**Rhododendron anthopogon** D. Don
Tali 3600 m. ; *Uniyal* 1296.

**R. arboreum** Smith
Ghuttu 1600 m. ; *Uniyal* 1134.

**R. campanulatum** D. Don
Rajkhark 3300 m. ; *Uniyal* 1286.

**R. lepidotum** Wall.
Tali 3600 m. ; *Saxena* 819.

## PLUMBAGINACEAE

**Plumbago zeylanica** Linn.
Ghansali 900 m. ; *Uniyal* 573.

## PRIMULACEAE

**Androsace lanuginosa** Wall.
Poibagi 2400 m. ; *Uniyal* 684.

**A. rotundifolia** Hardw.
Gangi 2100 m. ; *Uniyal* 1455.

**A. umbellata** Merr.
Chamba 1500 m. ; *Saxena* 1047.

**Lysimachia alternifolia** Wall. ex Roxb.
Tali 3800 m. ; *Saxena* 772.

**L. chenopodioides** Wall. ex Hook. f.
Gangi 2100 m. ; *Saxena* 1142.

**L. japonica** Thunb.
Gangi 2100 m. ; *Saxena* 1147.

**L. lobelioides** Wall.
Ghansali 900 m. ; *Uniyal* 749.

**L. pyramidalis** Wall.
Ghansali 900 m. ; *Uniyal* 749.

**Primula petiolaris** Wall.
Poibagi 2500 m. ; *Dey* 1256.

**P. stewartii** Wall.
Tali 3300 m. ; *Uniyal* 862.

## Myrsinaceae

**Maesa indica** (Roxb.) Wall.
Ghansali 900 m. ; *Saxena* 732.

## Symplocaceae
(Styraceae)

**Symplocos chinensis** (Lour.) Druce
Ghuttu 1500 m. ; *Uniyal* 695.

## Oleaceae

**Jasminum dispermum** Wall.
Ghuttu 1800 m. ; *Uniyal* 1112.

**J. humile** Linn.
Ghuttu 1800 m. ; *Uniyal* 1112.

**J. officinale** Linn.
Ponwali 1800 m. ; *Uniyal* 1218.

**J. pubescens** Willd.
Ghansali 900 m. ; *Saxena* 688.

**Syringa emodi** Wall. ex D. Don
Ponwali 3000 m. ; *Uniyal & Saxena* 678 & 1235.

## Apocynaceae

**Carissa opaca** Stapf.
Ghuttu 1200 m. ; *Uniyal* 1076.

**Vallaris heynei** Spreng.
Indrola 900 m. ; *Uniyal* 705.

## Asclepiadaceae

**Asclepias curassavica** Linn.
Ghuttu 1500 m. ; *Uniyal* 1093.

**Cryptolepis buchanani** R. & S.
Indrola 900 m. ; *Uniyal* 3678.

**Cynanchum glaucum** Wall.
Poibagi 2400 m. ; *Saxena* 1208.

**C. vincetoxicum** Pers.
Poibagi 2400 m. ; *Uniyal* 1252.

**Hoya longifolia** Wall.
Ghansali 900 m. ; *Uniyal* 699.

**Marsdenia roylei** Wight.
Ghuttu 1500 m. ; *Uniyal* 1118.

**Tylophora govanii** Decne.
Ghuttu 1500 m. ; *Uniyal* 1619.

## Gentianaceae

**Gentiana carinata** Griseb.
Tali 3600 m. ; *Saxena* 861.

**G. pedicellata** Wall.
Gangi 2100 m.; *Uniyal* 799.

**Halenia elliptica** D. Don
Ponwali 3000 m.; *Uniyal* 1486.

**Swertia alata** Royle
Ponwali 3000 m.; *Uniyal* 3620.

**S. angustifolia** Buch.-Ham.
Ghuttu 900 m.; *Uniyal* 1620.

**S. purpurascens** Wall.
Banchuri 1800 m.; *Uniyal* 3644.

## Boraginaceae

**Cynoglossum micranthum** Desf.
Ponwali 3300 m.; *Dey* 1325.

**C. wallichii** D. Don
Ponwali 3000 m.; *Uniyal* 1415.

**Hackelia glochidiata** (A. DC.) Brand.
Ponwali 3000 m.; *Uniyal* 3876.

**Lindelofia spectabilis** Lehm.
Tali 3600 m.; *Saxena* 885.

**Macrotomia benthami** DC.
Tali 3600 m.; *Saxena & Uniyal* 863.

**Trichodesma indicum** R. Br.
Sarana 900 m.; *Uniyal* 696.

## Convolvulaceae

**Evolvulus alsinoides** Linn.
Tehri 600 m.; *Dey* 1072.

**Ipomoea hederifolia** Linn.
Ghansali 900 m.; *Saxena* 742.

**I. purpurea** Lam.
Ghuttu 1800 m.; *Uniyal* 1207.

### SOLANACEAE

**Datura stramonium** Linn.
Ghuttu 1500 m.; *Uniyal* 4280.

**Nicandra physaloides** Gaertn.
Ghuttu 1800 m.; *Uniyal* 1144.

**Nicotiana tabacum** Linn.
Ghansali 900 m.; *Uniyal* 768.

**Physalis minima** Linn.
Indrola 900 m.; *Uniyal* 4270.

**Solanum nigrum** Linn.
Ghonti 900 m.; *Uniyal* 4269.

**S. verbascifolium** Linn.
Ghansali 900 m.; *Uniyal* 1312.

**Withania somnifera** Dunal.
Tehri 700 m.; *Uniyal* 4229.

### ARISTOLOCHIACEAE

**Aristolochia dilatata** N.E. Brown
Gangi 2400 m.; *Uniyal* 852.

### SCROPHULARIACEAE

**Hemiphragma heterophyllum** Wall.
Ponwali 3000 m.; *Saxena* 661 & *Uniyal* 1269.

**Lagotis glauca** Gaertn.
Tali 3600 m.; *Saxena* 865.

**Mazus surculosus** D. Don
Ghansali 900 m.; *Saxena* 756.

**Lathraea squamaria** Linn.
Tali 3600 m.; *Uniyal* 672.

**Pedicularis bicornuta** Klotz
Mataya 2400 m.; *Saxena* 1465.

**P. gracilis** Wall. ex Benth.
Mataya 2700 m.; *Uniyal* 3387.

**Picrorhiza kurroa** Benth.
Rajkhark, Ponwali 3300-3600 m.; *Uniyal* 1667 & 3843.

**Scrophularia himalensis** Royle
Ghuttu 1500 m.; *Saxena* 1300.

**Veronica javanica** Bl.
Kalayani 2400m.; *Saxena* 1180

### GESNERIACEAE

**Didissandra lanuginosa** C. B. Cl.
Ghuttu 1200 m.; *Saxena* 725.

**Didymocarpus sabalternans** Wall.
Gangi 2400 m.; *Saxena* 782.

## ACANTHACEAE

**Adhatoda vasica** Nees
Indrola 900 m.; *Uniyal* 3682.

**Barleria cristata** Linn.
Ghansali 900 m.; *Uniyal* 1606.

**Rungia pectinata** Nees
Ghonti 900 m.; *Uniyal* 650.

**Pteracanthus alatus** (Wall. ex Nees) Brem.
Gangi 2100 m.; *Saxena* 1371.

## VERBENACEAE

**Callicarpa macrophylla** Vahl
Ghansali 900 m.; *Uniyal* 729 & 588.

**Clerodendrum serratum** Spreng.
Sarana 900 m. ; *Uniyal* 1616 & 697.

**Premna barbata** Wall. ex Shauer.
Sarana 900 m.; *Uniyal* 1068.

**P. latifolia** Roxb.
Ghuttu 1500 m.; *Saxena* 3892.

**Pygmaeopremna herbacea** (Roxb.) Moldenke
Sarana 900 m.; *Uniyal* 3871.

## LABIATAE

**Ajuga bracteosa** Wall.
Pukhar 1200 m.; *Dey* 1063.

**A. parviflora** Benth.
Mataya 2700 m.; *Uniyal* 1206.

**Anisomeles indica** Ktze.
Ghansali 900 m.; *Saxena* 777.

**Calamintha umbrosa** Benth.
Chamba 1200 m.; *Uniyal* 580.

**Lamium album** Linn.
Duphand 2700 m.; *Uniyal* 1250.

**Leucas lanata** Benth.
Ghonti 900 m.; *Uniyal* 649.

**L. mollissima** Wall.
Ghonti 900 m.; *Uniyal* 651.

**Micromeria biflora** Benth.
Ghuttu 1500 m.; *Uniyal* 680.

**Prunella vulgaris** Linn.
Gangi 2400 m.; *Uniyal* 1176.

**Roylea cinerea** (D. Don) Baill.
Pukhar 1200 m.; *Uniyal* 1083.

**Salvia plebeia** Br.
Ghuttu 1500 m.; *Saxena* 752 & 1229.

**Teucrium royleanum** Wall.
Ghonti 900 m.; *Uniyal* 710.

**Thymus serpyllum** Linn.
Sahshratal 3800 m.; *Uniyal* 1376.

### PLANTAGINACEAE

**Plantago major** Linn.
Ponwali 3000 m.; *Uniyal* 1283.

### AMARANTHACEAE

**Alternanthera sessilis** R. Br.
Ghansali 900 m.; *Uniyal & Saxena* 733 & 775.

**Aerva sanguinolenta** (L.) Blume
Ghuttu 1200 m.; *Uniyal* 1084.

**Celosia argentea** Linn.
Ghansali 900 m.; *Uniyal* 759.

### POLYGONACEAE

**Fagopyrum cymosum** Meis.
Ghuttu 1500 m.; *Uniyal* 1073.

**Polygonum amplexicaule** D. Don
Gangi 2400 m.; *Uniyal* 1178.

**P. capitatum** Buch.-Ham.
Ghuttu 1500 m.; *Saxena* 1085.

**P. chinense** Linn.
Gangi 2400 m.; *Saxena* 788.

**P. nepalense** Meis.
Ghuttu 1500 m.; *Uniyal* 1091.

**P. sphaerostachyum** Meis.
Ponwali 3500 m.; *Uniyal* 890.

**P. vaccinifolium** Wall. ex Meis.
Ponwali 3000 m.; *Uniyal* 1505.

**Rheum emodi** Wall.
Khatling 4000 m.; *Uniyal* 3880.

**Rumex hastatus** D. Don
Ghansali 900 m.; *Uniyal* 585.

### PIPERACEAE

**Peperomia tetraphylla** (G. Forst.) Hook. & Arn.
Ghansali 900 m.; *Saxena* 736.

### LAURACEAE

**Cinnamomum tamala** Nees
Indrola 1000 m.; *Uniyal* 701.

**Litsea umbrosa** Nees
Gangi 2100 m.; *Saxena* 800.

**Machilus gamblei** King
Poibagi 2100 m.; *Uniyal* 714.

## THYMELEACEAE

**Daphne papyracea** Decne.
Poibagi 2100 m.; *Uniyal* 1288.

**Wickstroemia canescens** Meis.
Mataya 2400 m.; *Uniyal* 1388.

## ELAEAGNACEAE

**Elaeagnus umbellata** Thunb.
Kalayani 2400 m.; *Uniyal* 1181.

## LORANTHACEAE

**Scurrula elata** (Edgew.) Dans.
Parasitic on *Lynoia ovalifolia*; Ghuttu 1500 m.; *Saxena* 1253.

**Taxillus vestitus** (Wall.) Dans.
Parasitic, growing on rocks, at Ghuttu 1500 m.; *Uniyal* 1656.

**Viscum nepalense** Spreng.
Parasitic on *Loranthus* sp. on *Quercus incana*, at Poibagi 2100 m.; *Uniyal* & *Saxena* 1222 & 1655.

## SANTALACEAE

**Osyris wightiana** Wall. ex Wight
Ghansali 900 m.; *Uniyal* 728.

## EUPHORBIACEAE

**Andrachne cordifolia** Muell.-Arg.
Ghuttu 1200 m.; *Uniyal* 744.

**Euphorbia pilosa** Linn.
Poibagi 2400 m.; *Uniyal* 1103.

**E. royleana** Boiss.
Ghonti 900 m.; *Dey* 1059.

**Glochidion velutinum** Wight
Ponwali 3000 m.; *Uniyal* 1065.

**Mallotus philippinensis** Muell.-Arg.
Ghonti 900 m.; *Uniyal* 890.

**Phyllanthus parvifolius** Ham.
Ghuttu 1800 m.; *Uniyal* 1654.

**Sarcococca saligna** Muel.-Arg.
Ghuttu 1500 m.; *Uniyal* 1094.

## URTICACEAE

**Celtis tetrandra** Roxb.
Ghonti 900 m.; *Uniyal* 724.

**Debregeasia hypoleuca** Wedd.
Ghuttu 1500 m.; *Dey* 1229.

**Ficus clavata** Wall.
Ghuttu 1500 m.; *Uniyal* 1058.

**F. palmata** Forsk.
Ghuttu 1500 m.; *Uniyal* 1059.

**Maoutia puya** Wedd.
Ghansali 900 m.; *Saxena* 1323.

**Pilea scripta** Wedd.
Gangi 2100 m.; *Saxena* 791.

**Trema politoria** Planch.
Ghuttu 1200 m.; *Uniyal* 1087.

### JUGLANDACEAE

**Engelhardtia spicata** Bl.
Pukhar 1200 m.; *Uniyal* 1133.

### MYRICACEAE

**Myrica nagi** Thunb.
Banchuri 1500 m.; *Uniyal* 721.

### BETULACEAE

**Alnus nepalensis** D. Don
Poibagi 2400 m.; *Uniyal* 1110.

**Betula utilis** D. Don
Tali 3800 m.; *Uniyal* 3878.

**Carpinus viminea** Lindl.
Mataya 2400 m.; *Saxena* 1114.

### FAGACEAE

**Quercus incana** Roxb.
Banchuri 1500 m.; *Uniyal* 3800.

**Q. semecarpifolia** Sm.
Ponwali 3000 m.; *Uniyal* 1221.

### SALICACEAE

**Salix elegans** Wall. ex Anderss.
Rajkhark 3300 m.; *Uniyal* 4270.

**S. tetrasperma** Roxb.
Ghuttu 1800 m.; *Uniyal* 4271.

### ORCHIDACEAE

**Calanthe tricarinata** Lindl.
Gangi 2400 m.; *Saxena* 1186.

**Cephalanthera ensifolia** Richard
Tali 3600 m.; *Uniyal* 668.

**Cypripedium cordigerum** D. Don
Tali 3600 m.; *Uniyal* 6669.

**Dendrobium alpestre** Royle
Ghuttu 1800 m.; *Uniyal* 3620.

**Eulophia campestris** Wall.
Ponwali 3000 m.; *Uniyal* 664 & 892.

**E. herbacea** Lindl.
Pukhar 1500 m.; *Uniyal* 1318.

**Eria alba** Lindl.
Gangi 2100 m.; *Uniyal* 783.

**Habenaria intermedia** D. Don
Ghuttu 1800 m.; *Uniyal* 794.

**Herminium monorchris** Br.
Ghuttu 1500 m.; *Uniyal* 1311.

**Luisia teretifolia** Gaud.
Ghansali 900 m.; *Uniyal* 700.

**Microstylis muscifera** (Lindl.) O. Kuntze
Ponwali 3000 m.; *Uniyal* 3617.

**Orchis latifolia** Linn.
Ponwali 3000 m.; *Uniyal* 833 & 3345.

**Pholidota articulata** Lindl.
Pukhar 1500 m.; *Uniyal* 3885.

**Vanda parviflora** Lindl.
Ghonti 900 m.; *Uniyal* 590.

## SCITAMINACEAE

**Roscoea procera** Wall.
Gangi 2100 m.; *Uniyal* 1349.

**R. alpina** Royle
Poibagi 2100 m.; *Uniyal* 3875.

**Curcuma angustifolia** Roxb.
Ghuttu 1500 m.; *Uniyal* 3640.

## HYPOXIDACEAE

**Hypoxis aurea** Lour.
Ghuttu 1500 m.; *Uniyal* 1152.

## IRIDACEAE

**Iris ensata** Thunb.
Gangi 2400 m.; *Saxena* 795.

## DIOSCOREACEAE

**Dioscorea deltoidea** Wall.
Ghuttu 1500 m.; *Uniyal* 1100.

## LILIACEAE

**Allium stracheyi** Baker
Kinkoliya Khal 3600 m.; *Uniyal* 3894.

**A. govanianum** Wall.
Tali 3600 m.; *Uniyal* 3852.

**Asparagus curillus** Buch.-Ham.
Ghonti 900 m.; *Uniyal* 448.

**A. gracilis** Royle
Indrola 900 m.; *Uniyal* 703 & 1089.

**A. filicinus** Buch.-Ham.
Gangi 2400 m.; *Uniyal* 3894.

**Disporum pullum** Salisb.
Ghuttu 1500 m.; *Uniyal* 1118.

**Fritillaria roylei** Hook.
Mataya 2800 m.; *Saxena* 658.

**F. cirrhosa** D. Don
Ponwali 3000 m.; *Uniyal* 1188.

**Lilium polyphyllum** D. Don
Ponwali 3000 m.; *Uniyal* 1459.

**L. roseum** Wall.
Banchuri 1500 m.; *Uniyal* 4228.

**Nomocharis oxypetala** (Royle) Balf. f.
Tali 3600 m.; *Uniyal* 879.

**N. nana** (Klotzsch.) E. H.
Tali 3600 m.; *Uniyal* 3879.

**Polygonatum cirrhifolium** Royle
Gangi 2400 m.; *Uniyal* 763 & 3876.

**P. verticillatum** All.
Ponwali 3000 m.; *Uniyal* 616.

**Smilax aspera** Wall.
Indrola 1000 m.; *Uniyal* 616.

**S. parvifolia** Wall.
Ghuttu 1500 m.; *Uniyal* 694.

**Trillium govanianum** Wall.
Ponwali 3000 m.; *Uniyal* 662.

## JUNCACEAE

**Juncus membranaceus** Royle
Ponwali 3000 m.; *Uniyal* 889.

## ARACEAE

**Arisaema tortuosum** Schott.
Ghuttu 1800 m.; *Uniyal* 784.

**Gonatanthus pumilus** (D. Don) Engl. & Krause.
Mataya 2400 m.; *Uniyal* 1307.

**Remusatia hookeriana** Schott.
Mataya 2100 m.; *Uniyal* 716.

## Taxaceae

**Taxus baccata** Linn.
Ponwali 3000 m.; *Uniyal* 872 & 1266.

## Pinaceae

**Abies pindrow** (Royle) Spach.
Ponwali 3000 m.; *Saxena* 873.

**Pinus roxburghii** Sargent
Ghonti 900 m.; *Uniyal* 618.

**Pinus excelsa** Wall.
Ganwali 2100 m.; *Uniyal* 4273.

**Cedrus deodara** Loud.
Gangi 2400 m.; *Uniyal* 435.

## Cupressaceae

**Juniperus communis** Linn.
Kinkolya-khal 3600 m.; *Uniyal* 4228.

**J. recurva** Buch.
Khatalingh 4200 m.; *Uniyal* 4275.

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# On the occurrence of *Triops mavliensis* (Tiwari), Notostraca (Crustacea), in the Okhamandal Region of Saurashtra (India)

BY

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(*With four text-figures*)

## Introduction

Like other Branchiopods, *Triops* is an archaic genus that has been evolutionarily stagnant since the Triassic period. Because of its rare occurrence, discontinuous distribution, variable sex ratio and peculiar mode of reproduction, it has attracted considerable attention. In India, major work on this group was done by Gurney (1925), Mahabale (1939), Tiwari (1952, 1954, 1956) and Karande & Inamdar (1959). Very little is known about the distribution of these forms, and information about their reproduction is also scanty. Till now *Triops* has been collected from nine different localities in India. They were first recorded from Gandharbar (7000 ft.) in Kashmir by F. Smith in 1907 and identified by Gurney (1925) as *Apus cancriformis* Schaefer. Kemp (1911) recorded this species from Kashmir, Sarghodha (now in Pakistan) and Bulundshahar (U.P.).

*Triops* also occurs in Panchgani (4378 ft.) in Maharashtra State. These were identified by Gurney (1925) as *Apus asiaticus* Gurney and were thought to be similar to those collected from Central Asia and Baghdad. Later, Tiwari (1952) redescribed the forms collected from Panchgani as a new species *Apus orientalis* Tiwari.

*Triops* is also recorded from Ahmedabad (Gujarat) by Mahabale (1939) who described them as *Apus cancriformis* Schaefer.

Sixteen female specimens of a *Triops* species collected at Mavli (Rajasthan) were described by Tiwari (1952) as a new species *Apus mavliensis* Tiwari. A single specimen of *Triops* recorded by Chacko (1950) from Tirunelveli (Madras) was later identified by Tiwari (1952) as *Apus*

*sudanicus* Brauer. Finally, Mathur & Sindhu (1956) recorded an unidentified species of *Triops* from Pilani (Rajasthan).

During recent visits to Port Okha (Gujarat) in June 1966 and August 1966, specimens of *Triops*, together with other Branchiopods, were collected from shallow freshwater ponds. Collections were made from three distinct places, namely, Okha town proper, Gopi village (12 miles from Okha) and Poshetra village (23 miles from Okha). These specimens were identified as *Triops mavliensis* (Tiwari), and have revealed a few facts about the biology of this species, including the morphology of the male, which have not been recorded before.

## OBSERVATIONS

The area from which collections were made was a coastline of coralline rocks with occasional very shallow ponds. The depth of these ponds does not exceed four feet. The annual rainfall of this region is 4 to 20 inches. The rainy months are from late June to September, the peak being in July and August. For most part of the year the ponds are dry, but with the onset of monsoon, they are filled and remain so for five to six weeks.

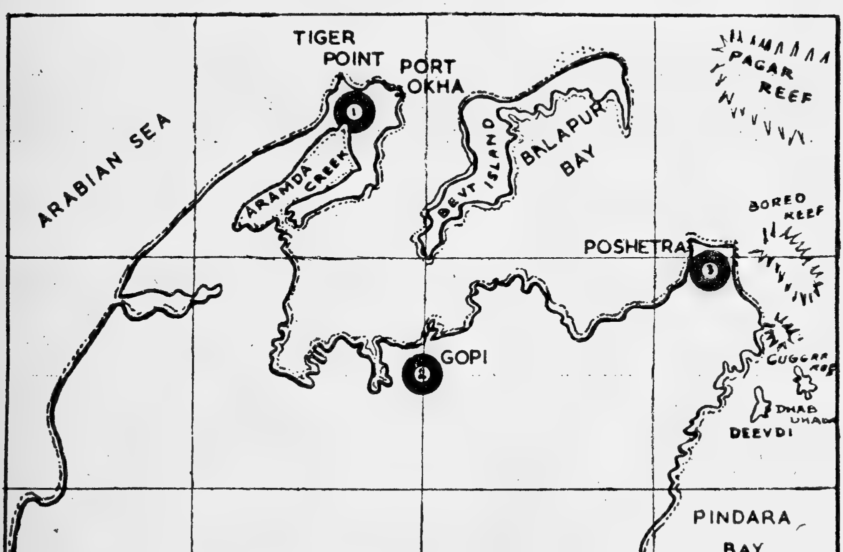


Fig. 1. Map of Okha and surrounding places from where *Triops* were collected.

Two visits to the area were made on 30 June and 15 August of the year 1966, and specimens of *Triops*, together with other Branchiopods, were collected from freshwater ponds. Places of collection are indicated

in Fig. 1. During the first visit 141 males and 238 females were collected, while during the second visit 21 males and 56 females were obtained.

The occurrence of *Triops* at high altitude led to the belief that the factors affecting their distribution are correlated with heavy rainfall, characteristic soil condition and low temperature. Barnard (1929) has also expressed similar views with regard to the South African species of *Triops*. However, our present collections were made from shallow ponds over coralline rocks, where climatic conditions are quite different from those prevailing at high altitudes. It is, therefore, obvious that the nature of soil, rainfall or temperature, are not the principal governing factors in the distribution of *Triops*.

The occurrence of *Triops* at sea-level has been recorded previously by Gurney (1907), Weldon (1909) and Balfour-Browne (1948) but this is the first record in India, at sea-level.

Phyllopods, except one species of *Branchipus* and one species of *Limnetis* (both cave-dwelling and blind) are not found in underground waters or wells. However, while collecting *Triops* from Poshetra (Fig. 1), from a flooded well, we also collected other Phyllopods namely *Eocyzicus* sp. and *Streptocephalus simplex* (Gurney).

## Morphology

The morphology of fifty-five females and fifty-three males were studied in detail, and compared with the description given by Tiwari (1952) which was based on only sixteen female specimens. The results are summarised in Tables 1 to 4.

Table 1

*Triops mavliensis* (Tiwari)—Female

| | | Tiwari's observations | Our observations |
|---|---|---|---|
| Total body length | .. | 8·8 to 15·8 mm. | 8·00 to 22·50 mm. |
| Apodal segments | .. | 8 to 10 | 8 to 10 |
| Sulcal spines | .. | 36 to 44 | 36 to 54 |
| Exposed segments behind sinus | .. | 20 to 24 | 15 to 26 |
| Post-genital segments | .. | 25 to 27 | 24 to 29 |
| Movable segments | .. | 36 to 39 | 35 to 41 |

With the exception of the above variation in measurements and number, our specimens agree in general with the description of the female by Tiwari (1952).

Table 2 shows the distribution of morphological variations in the female.

TABLE 2

*Triops mavliensis* (Tiwari)—FEMALE. DISTRIBUTION OF VARIATIONS IN MORPHOLOGY

| *Character* | | *Distribution* | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Apodal Segments | Number | 8 | 9 | 10 | | | | | | | | | | |
| | Individuals | 14 | 39 | 2 | | | | | | | | | | Total Individuals=55 |
| Exposed Segments | Number | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | |
| | Individuals | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 4 | 18 | 10 | 11 | 7 | Total Individuals=55 |
| Post-genital Segments | Number | 24 | 25 | 26 | 27 | 28 | 29 | | | | | | | |
| | Individuals | 1 | 6 | 16 | 24 | 6 | 2 | | | | | | | Total Individuals=55 |
| Movable Segments | Number | 35 | 36 | 37 | 38 | 39 | 40 | 41 | | | | | | |
| | Individuals | 2 | 7 | 18 | 15 | 7 | 3 | 3 | | | | | | Total Individuals=55 |

Males were collected in fairly large numbers. There is, however, a clear distinction between the two sexes in this species, as in many others. The males are yellowish brown in colour while the females are light green. This character is clearly seen when the specimens are fresh. The carapace (Fig. 2) is oval in the female. This character is distinctive in females

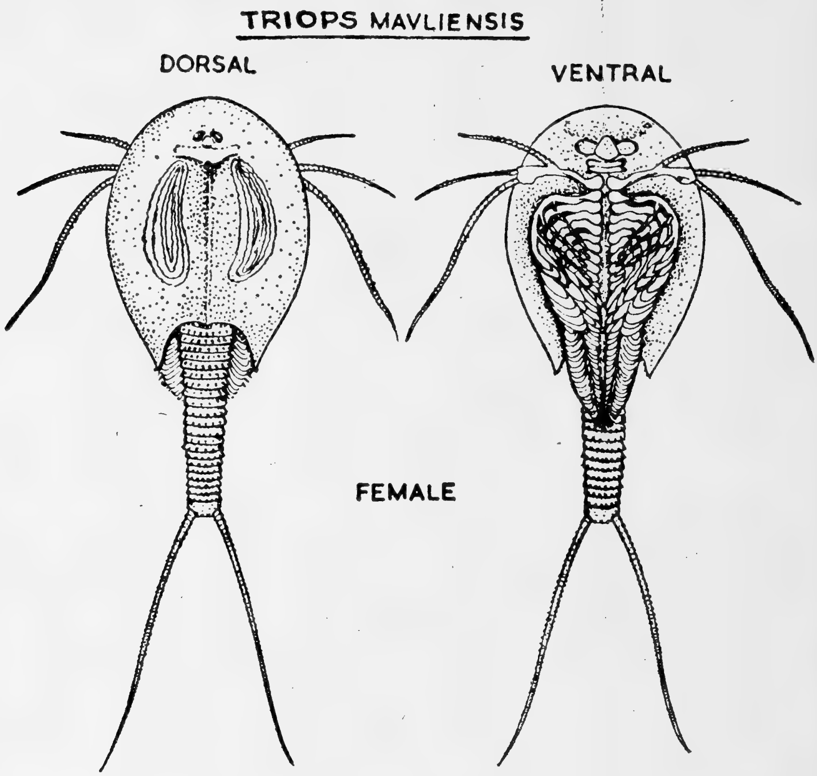


Fig. 2. Dorsal and ventral views of female *Triops mavliensis* (Tiwari).

because of the curvature in the mid-dorsal region. In the male, however, the carapace (Fig. 3) is almost flat, thus appearing more or less circular. The shape of the carapace as well as the colour are often variable, and hence cannot be accepted as dimorphic characters. A more dependable dimorphic character, according to our observations, is the armature of the telson. The spines on the dorsal surface of the telson are more or less similar in both the sexes. The armature of the ventral side, however, differs in the two sexes (Fig. 4). In the male, the ventral median spines and the post-marginal spines are short, stout and brown (due to chitinous material) whereas in the female they are slender, weak and yellowish. This difference, though not seen in other species of *Triops*, is very distinctly seen in this species. Out of the 238 females

TABLE 3

*Triops mavliensis* (Tiwari)—MALE. DISTRIBUTION OF VARIATIONS IN MORPHOLOGY

| *Character* | | *Distribution* | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Apodal Segments | Number | 11 | 12 | 13 | | | | | | | | | | |
| | Individuals | 16 | 29 | 8 | Total Individuals=53 | | | | | | | | | |
| Exposed Segments | Number | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | |
| | Individuals | 1 | 0 | 0 | 4 | 3 | 2 | 15 | 5 | 8 | 9 | 5 | 1 | Total Individuals=53 |

in our first lot, there were 5 females (with brood pouch) which had a yellow and circular carapace characteristic of the male, but their telson

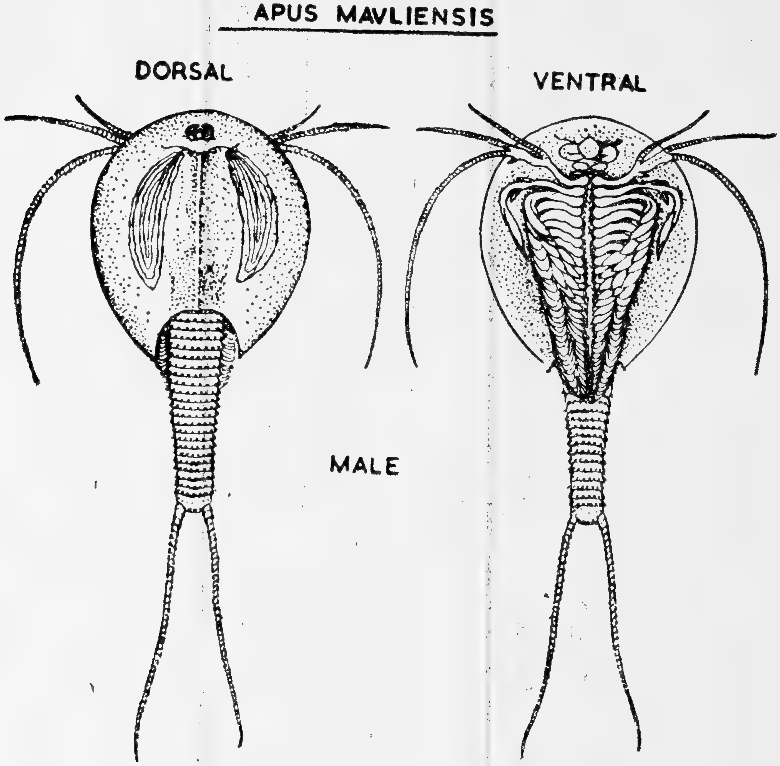


Fig. 3. Dorsal and ventral views of male *Triops mavliensis* (Tiwari).

showed the distinctive female characteristics. The furcal spines also differ in the two sexes to a certain extent. They are slender and yellowish in the female, and are shorter and brownish in the male. This distinction requires careful examination.

The characteristics of the male of *Triops mavliensis* (Tiwari) are as follows.

TABLE 4

*Triops mavliensis* (Tiwari)—MALE

| | | |
|---|---|---|
| Total body length | .. | 9·50 to 21.00 mm. |
| Apodal Segments | .. | 11 to 13 |
| Sulcal spines | .. | 38 to 51 |
| Exposed segments | .. | 18 to 28 |

In all 53 males were examined out of a collection of 162. Table 3 shows the distribution of variation in morphology of the male.

## Sex Ratio

The sex ratio is considered to be variable in *Triops* and males are said to be rare amongst European species. Main (1953) records that males

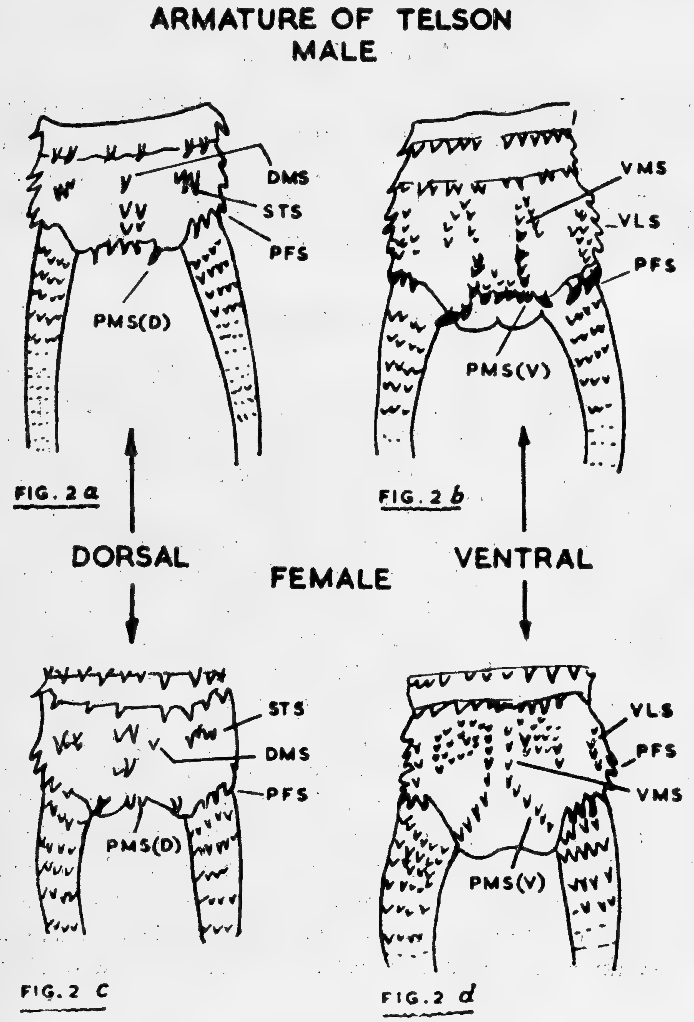


Fig. 4. Armature of telson of male and female specimens of *Triops mavliensis* (Tiwari).

DMS—Dorsal median spines.
PFS—Prefurcal spines.
PMS(D)—Posterior marginal spines—dorsal.
PMS(V)—Posterior marginal spines—ventral.
STS—Setal spines.
VLS—Ventro lateral spines.
VMS—Ventro median spines.

are abundantly found in Australian species. As far as Indian species are concerned Tiwari (1954) has recorded that males are not so rare in *Triops*

*orientalis* (Tiwari) while they are said to be rare in *Triops cancriformis* (Schaefer). The sex ratio in *Triops mavliensis* (Tiwari) in our collection works out at 37·5% males to 62·5% females. The occurrence of males decreases towards the end of the monsoon.

## Apodal Segments

The number of apodal segments is found to be highly variable in the Australian species of *Triops* (Main 1953) while in Indian species it is fairly constant (Tiwari 1954). This conclusion applies also to *Triops mavliensis* (Tiwari) which has been described in this paper. The number of apodal segments is 8 to 10 in females and 11 to 13 in males.

## Systematic Position

Longhurst (1955) considers the armature of the telson in different species of *Triops* as of great taxonomic importance, and basing his analysis on this he considers *T. longicaudatus* (LeConte), *T. australiensis* (Spencer & Hall), *T. cancriformes* (Bosc) and *T. granarius* (Lucas) to be the only valid species of *Triops*. In his opinion *T. orientalis* (Tiwari) and *T. mavliensis* (Tiwari) are synonymous with *T. granarius* (Lucas). The differences in these two species are, according to Longhurst (1955), due to geographic distribution. He further adds that there is a strong correlation between the spine pattern of the telson and the geographic distribution of these forms, but none with the sex. If this conclusion is based on the samples of *T. mavliensis* (Tiwari) sent to Longhurst from the Zoological Survey of India, then they are based only on the study of females. In our collection we examined a large number of males also, and found that there does exist a correlation between the telsonic spines and sex in this species. He explains the different pattern of telson in *T. mavliensis* (Tiwari) as due to immaturity of specimens, but our samples contained mature females possessing brood pouches with eggs, and their telson still differed from the general pattern described for *T. granarius* (Lucas). We therefore feel that *T. mavliensis* (Tiwari) is a valid species.

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# A Catalogue of the Birds in the Collection of the Bombay Natural History Society—2

## Anseriformes

BY

Humayun Abdulali

[*continued from Vol.* **65** (1) : 199]

This instalment covers 459 specimens of the Anatidae (Ducks, Geese, and Swans) up to Register No. 22981. Though it is probable that more ducks than any other kinds of birds are shot every year in India, good series of several species of duck are not available. No special efforts have been made to obtain such specimens and many of them, particularly of the swans and geese, are heads and roughly prepared skins sent by sportsmen either for identification or for confirmation of records. It is hoped that members, particularly in northern India, will keep this in mind and try and preserve specimens to establish the correctness of some of the records and to make the collection more complete. Small series of the resident species (Spotbill, Nakta, Cotton Teal, etc.) from different parts of the country would also be of value. Arrangements for skinning birds for the Society exist at New Delhi, Calcutta, and of course in Bombay, and offers from other places can also be examined.

75 **Branta ruficollis** (Pallas) (Lower Ob, Southern Russia) Siberian Redbreasted Goose **6** : 407

nil.

Stuart Baker and Mandy both saw this species on the Brahmaputra in Assam, but no specimen appears to have been obtained in India. Vaurie (p. 93) omits it for our area.

EL **Anser fabalis fabalis** (Latham) (Great Britain) Bean Goose

**2 : 1** ♂, **1** ♀ *Denmark.*

76 ? **Anser fabalis middendorffi** Severtzov (Oudskoi Ostrog) Bean Goose (of which one form is the Pinkfooted Goose) **6** : 404.

nil.

77 ? **Anser fabalis rossicus** Buturlin (West Siberian Tundra) Tundra Bean Goose

nil.

Neither subspecies has been definitely recorded from Indian limits, though the former was reported from Burma (FAUNA **6** : 404)

77a **Anser fabalis neglectus** Sushkin (East Russia) Sushkin's Goose **6** : 403

Specimen No. 15292 o? Imphal, Manipur, Assam, recorded as *Anser neglectus*, has the wing 467, tarsus 70, and bill 63. The bill has a black tip to both upper and lower mandibles, and the black at the base of the upper mandible extends beyond the nostrils.

According to BR. HANDBOOK (**3** : 197) '*A. f. neglectus* has a slender pink bill and pink feet and may be a fairly frequent individual variation or localized in a breeding area not yet discovered'.

In a footnote Ripley (p. 25) refers to Sushkin's Bean Goose, *A. f. neglectus*, being recorded from Assam, and adds that this is now considered merely a colour phase of the mixed population *fabalis rossicus*, presumably referring to two subspecies *fabalis* and *rossicus*.

78 **Anser fabalis brachyrhynchus** Baillon (France) Pinkfooted Goose **6** : 401

1 ♂ *Denmark* (Reg. No. 22171).

Wing 433; bill 49 ; tarsus 70

There appears to be no satisfactory evidence as yet for the occurrence of this bird in Indian limits, the last 'authentic' record being a wrongly identified *Anser albifrons* from Bikaner (see Abdulali, *JBNHS* **63** : 198).

79 **Anser albifrons albifrons** (Scopoli) (North Italy) Whitefronted Goose **6** : 399

5 : 4 heads only ; 1 immature.

3 *Mesopotamia* ; 1 Imphal, Manipur ; 1 Bikaner, Rajasthan.

The last specimen (Reg. No. 15293) was originally identified as *A. f. brachyrhynchus*.

80 **Anser erythropus** (Linnaeus) (North Sweden) Lesser Whitefronted Goose **6** : 401

2 : 1 ♂ 1 o?

1 *Mesopotamia* (registered as *albifrons*) ; 1 Bahwalpur, West Punjab.

81 **Anser anser rubrirostris** Swinhoe (Shanghai) Greylag Goose **6** : 398

15 : 1 ♂ 4 ♀♀ 10 o? 2 albinoid ; 2 pull. ; 6 heads and necks.

2 *Mesopotamia* ; 4 *Shiraz, Persia* (2 adults with clipped wings and 2 pull.) ; 1 Kabul River, Peshawar ; 1 Punjab ; 2 Kashmir (albinoids) ; 2 Sind ; 1 Mandvi (Kutch ?) ; 2 no data.

In the absence of any suitable range of specimens, it is not possible to name any of them racially. The two white birds, both from Kashmir, include No. 15297 from Haigham Jheel, Srinagar, which was recorded as *Anser hyperboreus* (=*caerulescens*) and the present identification has resulted in the removal of this species from the Indian list (see Abdulali, *JBNHS* **63** : 198).

82 **Anser indicus** (Latham) (India) Barheaded Goose **6** : 405

6 : 3 ♂♂ 1 ♀ 2 o? 1 pull.*

1 Chitral* ; 2 Jabalpur, M.P. ; 2 Crawford Market, Bombay ; 1 Tungabhadra, Mysore.

83 **Anser caerulescens caerulescens** (Linnaeus) (Hudson Bay) Snow Goose

Specimen No. 15297 which is an albinoid *A. a. rubrirostris* was recorded as *A. hyperboreus* Pallas. This species is now removed from the Indian list (see Serial 81 above).

84 **Cygnus columbianus bewickii** Yarrel (Yarmouth, England) Bewick's or Whistling Swan **6** : 381

6 : 1 ♂ 5 o? 1 juv.* ; 2 juv. heads ; 1 leg only.

1 ♂ *Denmark*; 1 Mardan, N.W.F.P.; 2 Dora Momin, Kabul River; 1 leg, Jacobabad; 1 Rajpur, Delhi*.

There has been much confusion regarding the identification of some of our swans and geese, mainly due to lack of definitely identified material for comparison. A few specimens recently received in exchange from the Copenhagen Museum have permitted a more critical examination and I hope that my readjustments are correct. The two heads (juv.) obtained by Col. Magrath on the Kabul River in Peshawar District in 1910 were named *Cygnus cygnus* and are recorded in the FAUNA under this name. Their bills, from gape 88 and 94, compare better with the three others of this form (83, 85, and 88) rather than *C. cygnus* [101, 102, 105 (2)] and the yellow of the bill does not extend as far forward as the nostrils. The tops of their heads are also more like the juvenile of this species rather than of *cygnus*.

The label on the Jacobabad leg is marked *C. jankowskii*, while it was recorded by Stuart Baker as *bewickii JBNHS* **23** : 456.

85 **Cygnus columbianus jankowskii** Alpheraky (Ussuriland) **6** : 382

2 : 1 ♂ 1 o?

1 Campbellpur, Attock, Punjab ; 1 Kutch.

The wings measure 530 and 550, against 545, 505, and 512 in *bewickii*; the bills from gape are about equal to the last form but the feathers of the forehead commence further back and the bills measure 107 and 99 against 86-90(2) in the others.

Though there is an apparent difference in the size of the bill, it may be noted that Vaurie (1965 : 107 footnote) confirms the earlier finding of Tugarinov (1941, Fauna USSR., Ptitsy, 1, pt. 4, p. 117) that this is not a valid race.

86 **Cygnus cygnus** (Linnaeus) (Sweden) Whooper Swan **6** : 380

4 : 1 ♂ 1 o ? 2 heads only ; 1 grey plumage.*

1 *Denmark* ; 1 Khetri, Jaipur, Rajasthan* ; 1 River Beas, Punjab ; 1 Sind (?).

Except for Hodgson's specimens from Nepal (1829) these specimens appear to cover all known Indian records of this species.

87 **Cygnus olor** (Gmelin) (Russia) Mute Swan **6** : 383

7 : 1 ♂ 1 ♀ 5 o ? 1 imm. ; 4 heads only.

1 *Denmark* ; 1 *Persian Gulf* ; 1 *Persia* ; 1 N.W.F.P. ; 2 Punjab ; 1 Sind.

The two from Persian Gulf and Persia have their tarsi 78 and 85 against 102 in the ♂ from Denmark.

88 **Dendrocygna javanica** (Horsfield) (Java) Lesser Whistling Teal, Tree Duck **6** : 411

21 : 7 ♂♂ 8 ♀♀ 6 o ? 1 ch.

2 Rajputana ; 1 Gwalior ; 2 Kymore, M.P. ; 6 Bombay, 1 Bombay Market; 1 Karwar ; 1 Ceylon ; 2 Darbhanga, 2 Baghowni, Bihar ; 1 Calcutta Market, Bengal ; 1 Goalpara, 1 Sylhet, Assam.

One from Sylhet, Assam, has an irregular band of white across the breast continuing on to the shoulders of the wing and including the primaries. Fresh skins are much darker above than old ones, the black of the head fading into brown. Young birds have a more greyish wash and are less brown below.

A specimen of *D. fulva* (now *bicolor*) though correctly named on the label was listed with this species.

89 **Dendrocygna bicolor** (Vieillot) (Paraguay) Large Whistling Teal **6** : 413

1 ♂ Calcutta Market (5 Nov. 1899).

90 **Tadorna ferruginea** (Pallas) (Tartary) Ruddy Sheld-duck, Brahminy Duck **6** : 416

8 : 4 ♂♂ 2 ♀♀ 2 o ? 1 ch.

1 *Amara, Iraq* ; 1 *Aliabad, Shiraz, Iran* ; 1 Parman, Ladak* ; 1 Ghoti, 2 Bombay Market, Maharashtra; 1 Kheri, 1 Pilibhit, U.P.

The bills (from feathers) are smaller than indicated in the FAUNA : [4 ♂♂ 41-46 av. 44 (58-68) ; 2 ♀♀ 39-42 av. 40·5 (54-60)]

91 **Tadorna tadorna** (Linnaeus) (Sweden) Common Sheld-duck **6** : 414

15 : 2 ♂♂ 3 ♀♀ 10 o ? Several in immature plumage.

1 *Norway* ; 1 *Baghdad** ; 1 *Basra, Iraq* ; 1 *Aliabad, Shiraz, Iran* ; 2 Baluchistan; 2 Sind ; 1 Jamnagar, Gujarat ; 1 Baghowni, Bihar ; 1 Calcutta, 1 Calcutta Market, Bengal ; 2 *Burma* ; 1 *Tientsin, China.*

As in the last species, the bills are smaller than indicated in the FAUNA.

92 **Anas angustirostris** Menetries (Lenkoran, Transcaspia) Marbled Teal **6** : 445

11 : 6 ♂♂ 3 ♀♀ 2 o ?

2 *Iraq* ; 1 Ferozepur, Punjab ; 5 Sind ; 2 Gujarat ; 1 Ahmednagar, Maharashtra.

In this small series, the wings are smaller than suggested by the FAUNA : 6 ♂♂ 197-208 av. 203 (206-215) ; 3 ♀♀ 198-200 av. 199 (198-210).

93 **Anas acuta** (Linnaeus) (Sweden) Pintail **6** : 437

17 : 6 ♂♂ 8 ♀♀ 3 o ? 3 albino.

1 *Mesopotamia* ; 1 *Persian Gulf* ; 1 *Shiraz, Iran* ; 1 Chitral, N.W.F.P. ; 1 Sind ; 1 Kutch ; 1 Gujarat ; 1 Panvel, 1 Nasik, Maharashtra ; 1 Bihar ; 3 Calcutta Market, 1 Gangpur State, Bengal ; 2 Assam ; 1 *Tsingtaw, China.*

Some of the females have unmarked underparts while others are heavily spotted. Specimen No. 15441 (Calcutta Market) is a partial albino with greatly reduced markings washed with pale brown on the upperparts. Two other albinos (No. 15443-4) show some differences in the proportions of their bills, but all the measurements are within the range noted for the species.

94 **Anas crecca crecca** Linnaeus (Sweden) Common Teal **6** : 431

20 : 13 ♂♂ 5 ♀♀ 2 o ? 1 head only*.

1 *Emden, Germany* ; 2 *Mesopotamia* ; 1 *Iran* ; 1 Quetta, Baluchistan* ; 3 Sind ; 2 Chitral ; 1 Kashmir ; 1 Delhi ; 2 Calcutta Market ; 3 Ghoti, Maharashtra ; 2 *Burma* ; 1 *Peking, China.*

*The head displays gynandromorphism, in the form of the rufous and green eye-patch of the breeding male on one side and the female or winter plumage on the other (see Sálim Ali, *JBNHS* **44** : 127-130).

An excellent character by which it appears possible to separate this species from *Anas querquedula* is that the shafts of the primaries are brown against pure white in *querquedula*.

95 **Anas formosa** Georgi (Lake Baikal, Siberia) Baikal or Clucking Teal. **6** : 433

11 : 3 ♂♂ 2 ♀♀ 6 o ?

1 Dungagali, N.W.F.P. ; 1 Bhimasar, Kutch ; 1 Juhar, Ahmedabad ; 1 Bankipur, Patna, Bihar ; 4 Assam ; 2 *Tientsin*, 1 *Peking, China.*

One in female plumage was registered under *Anas querquedula* and another under *Nettion albogularis*, both from Assam.

The legs and feet of all the specimens appear as if they were originally red or orange.

The trivial name means 'pretty' from the Latin *formosus* (Delacour & Scott, WATERFOWL OF THE WORLD **2** : 103) and the name Formosa Teal, often applied to this species, is unwarranted.

96 **Anas gibberifrons albogularis** (Hume) (Andamans) Grey Teal **6** : 435

7 : 2 ♂♂ 4 ♀♀ 1 o?

3 Port Blair, South Andamans ; 4 Betapur, Middle Andamans.

For remarks on validity of Fleming's *leucopareus* from North Reef and Middle Andaman Islands, see Abdulali 1967 (*JBNHS* **64** : 154).

97 **Anas poecilorhyncha poecilorhyncha** Forster (Ceylon) Spotbill Duck **6** : 421

9 : 2 ♂♂ 2 ♀♀ 5 o? 1 albinoid.

1 Sirsa, Punjab ; 3 Bharatpur, Rajasthan ; 2 Daman, Gujarat ; 2 Nasik, Maharashtra ; 1 Upper Assam.

Wing 253-291 ; bill 55-61.

According to the FAUNA, the young are like the adults but with no red spots on the bill. Specimen No. 25356 from Sirsa, Punjab, has distinct red spots though it is not yet fully grown—bill 47 (next smallest measurement : 52) and wing 246 (248). The rump is also paler than in the adults and the head slightly but distinctly streaked—both apparently good characters of juvenility as supported by specimens of other races. Mr. M. J. S. Mackenzie of Chabua, Lakhimpur, Upper Assam, informs me (*in epist.*) that he had seen traces of red spots in three-week chicks.

The feathers of the forehead terminate in a point in some birds and in a short straight line in others. It has not been possible to associate this character with age or sex, but an examination of a larger and correctly sexed series may perhaps explain it.

98 **Anas poecilorhyncha haringtoni** (Oates) (Shan States) **6** : 423

9 ; 1 ♂ 1 ♀ 7 o?

8 *Taungyi, Southern Shan States* ; 1 *Fort Stedman, Burma.*

This race was separated from the nominate form mainly because of the absence of the red spots and the shorter bill. The latter character is omitted in the FAUNA, but the specimens available, mostly unsexed, have wings 248-274 and bills 50-56.

The fleshy spots at the base of the bill are distinctly present in some specimens, though now they all appear black, and not red. In the BIRDS OF BURMA, p. 551, it is stated that the position of the different races in Burma is not clear. Hopwood (*JBNHS* **18** : 498) said that all but one of a dozen shot on the Upper Chindwin had black patches at

the base of the bill while the exception (15th February) was pure orange. At the end of October in the same place 4 had orange patches with black centres. Is it possible that in Burma the colour changes seasonally? There is no evidence or suggestion that this is so in Indian birds. In preserved specimens also, the red spots are distinct in the oldest skins.

99 **Anas poecilorhyncha zonorhyncha** Swinhoe (Ningpo, China) Grey Duck **6** : 422

3 : 1 ♂ 2 o ?

1 Pasighat Sadiya, Frontier ; 2 Chabua, Upper Assam (see *JBNHS* **63** : 438-440).

100 **Anas platyrhynchos** Linnaeus (Sweden) Mallard **6** : 419

9 : 7 ♂♂ 2 ♀♀.

4 Chitral, N.W.F.P. ; 1 Sind ; 1 Bombay Market ; 1 *Upper Chindwin* ; 1 *Bhamo, Burma* ; 1 *Tientsin, China.*

While the wing measurements are in keeping with those in the FAUNA and BR. HANDBOOK the bills in both sexes appear to be larger than suggested therein :

7 ♂♂ 53-60 av. 56 (50-57 FAUNA; 50-56 HANDBOOK)

2 ♀♀ 52-53 av. 50·5 (44-55; 43-52)

This is confirmed to some extent by Ticehurst (Birds of Sind, *Ibis* 1923 : 446) who measured 'males 50-60·5 (mostly 54-58), females 47-55'.

In addition to the above, the collection includes a specimen (No. 15473) from Srinagar, Kashmir, which is very like a drake mallard but has a spatulate beak, and a green-purple speculum. It is marked as a hybrid between a mallard and a shoveller.

101 **Anas strepera strepera** (Linnaeus) (Sweden) Gadwall **6** : 426

16 : 10 ♂♂ 4 ♀♀ 2 o ? 1 juv.* ♀ ; 1 albino.

6 *Mesopotamia* and *Persian Gulf* ; 1 *Shiraz*, Iran* ; 3 Sind ; 1 Gujarat ; 3 Kolaba, 1 North Chanda, Maharashtra ; 1 Saran, Bihar.

The males are noticeably larger than the females, and have their wings 257-275 av. 268. These measurements are nearer those in the BR. HANDBOOK (3 : 244) 260-282 than in the FAUNA 270-285. The albino from Basra, Iraq, marked ♀ (wing 230), has her bill proportionately larger (44) and narrower (14) than in any of the others.

Specimen No. 15384 from Kashmir marked as a hybrid gadwall/mallard is not included above[1].

102 **Anas falcata** Georgi (Asiatic Russia) Falcated Teal **6** : 424

20 : 9 ♂♂ 5 ♀♀ 6 o ? 1 head only.

♂♂ wing 243-266 av. 253 ; bill 41-47 av. 44.

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[1] The five hybrid ducks in the collection are being separately reported on by Dr. J. Harrison in a later issue of the *Journal.*

♀♀ wing 226-259 av. 238 ; bill 37-43 av. 40.

1 Rawalpindi, 1 Jullundur, 3 Karnal, Punjab ; 1 Sind ; 1 Delhi ; 4 Roorkee, 1 Gonda, 1 Jogwala Jheel, Lhaskar, U.P. ; 2 Calcutta Market ; 1 Imphal, Manipur, 1 Chabua, Upper Assam ; 2 *Peking*, 1 *Tientsin, China.*

In Birds of Mesopotamia, *JBNHS* **28** : 331, a bird shot by Thornhill but not preserved is mentioned but the record is omitted in recent literature. H. S. Wood in MILESTONES OF MEMORY (1950) p. 145 refers to one shot in Mesopotamia during World War I ; I do not know if this is the same or another instance.

The collection contains two other birds (No. 15474 Imphal, Assam, and 15479 Calcutta Market) which are similar to the males of this species except that bills widen at the tip to varying extents and are 55 and 53 mm. long. One of them is marked in Sálim Ali's handwriting ' Bronze-capped Teal-Shoveller hybrid—Identified by E. C. Stuart Baker, who cannot explain the presence of chestnut on wings (His letter d/26.6.26) '. This letter is not now available.

103 **Anas penelope** Linnaeus (Sweden) Wigeon **6** : 429

25 : 12 ♂♂ 7 ♀♀ 6 o ? 1 albinoid.

1 *Germany* ; 1 *Mesopotamia* ; 3 *Iran* ; 2 Chitral, N.W.F.P. ; 3 Punjab ; 6 Sind ; 2 Nasik, 1 Panvel, Maharashtra ; 1 Delhi ; 1 Roorkee, 1 Dhanari, U.P. ; 2 Calcutta Market ; 1 *Upper Burma.*

The males have wings larger (248-261 av. 254) than the females (232-244 av. 238) but their bills are 32-37 and 31-36 both averaging 33.

A male from Roorkee, U.P., (No. 15403), is a partial albino having pale brown markings on the upper surface and being all white below.

104 **Anas querquedula** Linnaeus (Sweden) Garganey **6** : 439

22 : 10 ♂♂ 6 ♀♀ 6 o ?

2 Rawalpindi, Punjab ; 2 Sind ; 2 Bharatpur ; 2 Daman, Gujarat ; 4 Ghoti, 2 Bombay, Maharashtra ; 4 Calcutta Market ; 1 Alleppy, Kerala ; 2 *Lower Burma* ; 1 *Yarkand, China.*

Specimen No. 15456, unsexed, from Daman, Gujarat, has its bill from feathers 39 mm. long and which is very similar in shape to that of *A. crecca* as which it was originally registered. It has, however, blue shoulders and white shafts to the wing quills which render the present identification fairly certain.

105 **Anas clypeata** Linnaeus (South Sweden) Shoveller **6** : 442

18 : 8 ♂♂ 8 ♀♀ 2 o ?

2 *Mesopotamia* ; 1 *Persian Gulf* ; 2 Chitral, N.W.F.P. ; 1 Srinagar, 1 Garampani, Kashmir ; 1 Sind ; 2 Kharaghoda, Gujarat ; 1 Rewassa, Rajputana ; 5 Nasik, Maharashtra ; 2 Calcutta Market.

Five males with white upper breasts (24th December, January (2), March and ' April-August ') are apparently in breeding plumage but, though the sides of the head and neck are glossed with green, this colour

is absent at the top of the head. According to the FAUNA the whole head and neck is glossy green, but Delacour (WATERFOWL OF THE WORLD **2** : 187) says 'head metallic green, blackish on the crown, the face and the foreneck'.

106 **Rhodonessa caryophyllacea** (Latham) (India) Pinkheaded Duck **6** : 390

5 : 3 ♂♂ 1 ♀ 1 o?

1 Palia, north of Kheri District, U.P. (1921); 1 Darbhanga, Bihar (1903); 1 Alipore Zoo (1897); 1 Calcutta Market (1899); 1 *Sinju Kulag, Mandalay District, Upper Burma* (1909).

Burma is excluded from the range of this species, now believed to be extinct, in the SYNOPSIS, but the above specimen was recorded (*JBNHS* **19** : 264) and there are earlier records from Arakan and Bhamo.

107 **Netta rufina** (Pallas) (Caspian Sea) Redcrested Pochard **6** : 448

17 : 7 ♂♂ 7 ♀♀ 3 o?

1 *Persian Gulf*; 1 *Mesopotamia*; 1 *Shiraz, Persia*; 1 Rawalpindi, N.W.F.P.; 5 Sind; 1 Ahmednagar; 1 Vizianagram, south India; 1 Rajputta Saran, Bihar; 2 Calcutta Market; 1 Gauhati, Assam; 2 *Mandalay, Burma*.

The bill in some specimens, particularly males, appears to taper more prominently than in others.

108 **Aythya ferina** (Linnaeus) (Sweden) Common Pochard **6** : 450

15 : 8 ♂♂ 5 ♀♀ 2 o?

1 *Mesopotamia*; 1 Rawalpindi, N.W.F.P.; 1 Jhalwar, Rajputana; 1 Indore, Central India; 1 Saugor, Madhya Pradesh; 2 Saran, Bihar; 3 Nasik, 2 Thana, 1 Bombay Harbour, Maharashtra; 2 Calcutta Market.

| | Wing | | | Bill | | |
|---|---|---|---|---|---|---|
| ♂ | 200-215 | av. 207 | (210-225) | 47-52 | av. 49 | (43-50) |
| ♀ | 199-201 | av. 200 | (200-213) | 45-47 | av. 46 | |

109 **Aythya nyroca** (Guldenstadt) (S. Russia) White-eyed Pochard **6** : 453

16 : 7 ♂♂ 5 ♀♀ 4 o?

3 *Persian Gulf*; 1 *Aliabad, Iran*; 1 Nowshera, N.W.F.P.; 1 Larkana, Sind; 1 Ghoti, Nasik, 1 Greater Bombay, Maharashtra; 1 Saugor, Madhya Pradesh; 1 Meerut, U.P.; 3 Calcutta Market; 3 Assam.

The bills in 6 males measure 38-43 av. 41 (4 females 39-42 av. 40) against 27-30 in the FAUNA and 40-43 in BR. HANDBOOK (**3** : 292).

Specimen Nos. 15529 (Calcutta Market) and 15332/3 (Imphal, Assam) differ in having no pure white on the underparts, this being replaced by a greyish brown, many of the feathers (almost entirely in one) having whitish margins. The only bird sexed, a male, shows signs of typical reddish brown on the head and upper breast. This is apparently a sub-adult plumage of which there does not appear to be any mention in the standard literature available to us.

110 **Aythya baeri** (Radde) (upper Salbatch Plain, middle Amur River, Siberia) Baer's Pochard **6** : 454

4 : 3 ♂♂ 1 ♀.

2 Calcutta Market ; 1 Manipur, Assam ; 1 *Peking, China.*

The males have their wings 208 (2) 209 (208-240), and the female 198 (193-215) and the bills 46-47 (2) in the males and 41 in the female, against 39-42 in the FAUNA, presumably for both sexes.

In addition to the dark head, both sexes are noticeably larger than *A. nyroca.*

Specimen No. 15534, a female from Patao, Upper Burma, listed in this species is paler all over and has been identified as *N. fuligula* by Dr. Ripley to whom it was sent.

111 **Aythya fuligula** (Linnaeus) (Sweden) Tufted Duck **6 :** 458

17 : 6 ♂♂ 9 ♀♀ 2 o ?

1 Pithoro, Sind ; 1 Viramgam, Gujarat ; 2 Bharatpur, Rajasthan ; 1 Agra, U.P. ; 1 Gwalior ; 2 Ghoti, 2 Thana, 1 Ratnagiri, Maharashtra ; 1 Jeypore, Orissa ; 2 Calcutta Market ; 1 *Patao, Upper Burma,* 1 *Prome District, Burma* ; 1 *Tientsin, China.*

112 **Aythya marila marila** (Linnaeus) (Lapland) Scaup Duck **6** : 456

2 : 1 ♂ 1 o ?

1 Imphal, Manipur ; 1 Ahmednagar, Maharashtra.

The male from Imphal (No. 15539) has its wings 203 (♂ 220-230 ; ♀ 210-220. BR. HANDBOOK **3** : 307) and the other, which is very similar in appearance, 215 mm. The vermiculations on the upper surface are also vestigial and very different from those shown in the plate in BR. HANDBOOK. Accordingly both were sent to Dr. Ripley, who confirms that they are of the nominate form.

113 **Aix galericulata** (Linnaeus) (China) Mandarin Duck **6** : 394

2 : 1 ♂ 1 ♀ Imphal, Manipur, Assam.

This pair, which were among 4 birds shot and recorded in *JBNHS* **37** : 490 are omitted in the SYNOPSIS.

Both birds have larger wings, ♂ 244 (223-240) and ♀ 225 (170-197) than indicated in FAUNA though Delacour (1959, THE WATERFOWL OF THE WORLD **3** : 106) measures females 217-230.

114 **Nettapus coromandelianus coromandelianus** (Gmelin) (Coromandel, India) Cotton Teal **6** : 392

26 : 15 ♂♂ 8 ♀♀ 3 o ? 1 albino*. 1 juv.

2 Kutch ; 1 Ahmedabad, 2 Daman, Gujarat ; 1 Dhar, Central India ; 9 Thana, 1 Khandala, Maharashtra ; 1 Saugor, 1 Kanker, Madhya Pradesh ; 1 Yellapur, N. Kanara ; 1*Madras ; 1 Baghowni, Bihar ; 2 Calcutta Market, Bengal ; 1 Kheri, U.P. ; 1 *Ataran,* 1 *Little Tenasserim, Burma.*

The males have wings (153-172 av. 162) slightly larger than the females (151-160 av. 156·6) but the bills in both sexes range from 21-24 barely averaging larger in the males.

Blanford (**4** : 433) referred to a summer-winter plumage in males, but Stuart Baker described the former as an adult plumage and made no reference to seasonal changes. From the series available there can be little doubt that the 'final' plumage with black breast band, vermiculations at the sides, and black undertail coverts represents a breeding plumage acquired in March/ April and discarded by December or probably earlier. At this time only the white patch and the green on the wings separate them from the females.

A young male (19th February) is very like a female while another (3rd March) has acquired a little green on the upper-parts.

115 **Sarkidiornis melanotos melanotos** (Pennant) (Ceylon) Nakta, Comb Duck **6** : 385

13 : 5 ♂♂ (3 by size and plumage) 5 ♀♀ 3 o ?

2 Sind ; 1 Mahikanta, 2 Bhuj, Kutch, Gujarat ; 1 Dhar, C. I.; Handa, M.P. ; 3 Nasik, 1 Kolhapur, Maharashtra ; 1 Baghowni, Bihar ; 1 Calcutta Market.

The measurements, particularly of the bills, differ from those in the FAUNA :

| | Wing | Bill |
|---|---|---|
| ♂ | 335-370 av. 353 (339-406) | 52-60 av. 55 (63-70) |
| ♀ | 293-305 av. 298 (280-309) | 44-48 av. 47 (59-66) |

116 **Cairina scutulata** (S. Muller) (Java) Whitewinged Wood-Duck **6** : 387

10 : 4 ♂♂ 3 ♀♀ 3 o ?

1 Dibrugarh, 2 Sadiya, 2 Chungki, Manipur, 5 *Burma*.

In the small series some of the measurements are a little different from those in the FAUNA :

| | Wing | Bill |
|---|---|---|
| ♂ | 321-375 av. 343 (363-401) | 59-66 av. 62 (58-66) |
| ♀ | 315-341 av. 329 (305-356) | 58-61 av. 59 |

In view of the general paucity of information regarding the breeding habits of this bird (only one egg is referred to in NIDIFICATION) the following from Wood's SHIKAR MEMORIES (1934, p. 183) may be worth quoting : 'Close to one of the deserted tanks in heavy forest [near Dimapur, Sibsagar, Assam—H.A.], I saw an old tree bare of everything and in it there were six nests of the Wood-duck. Several were sitting at the time. Those eggs would be worth a lot of money now !'

117 **Clangula hyemalis** (Linnaeus) (Northern Sweden) Longtail or Old Squaw Duck

2 : 1 ♂ 1 ♀ (by plumage).
1 Chaman, Baluchistan ; 1 Drig, Larkana, Sind.

The male's wing is 211 against 219-236 in BR. HANDBOOK (**3** : 323).

118 **Bucephala clangula clangula** (Linnaeus) (Sweden) Goldeneye Duck **6** : 460

6 : 1 ♂ 5 ♀♀ (4 by plumage).
1 20 *miles from Babylon* ; 1 *Margil, Basra, Mesopotamia* ; 1 Kalabagh, Mianwali, 1 Jhelum, Punjab ; 1 Roorkee, U.P. ; 1 *Tientsin, China.*

The five females have their wings 189-202 av. 195, slightly smaller than 197-213 in FAUNA and 197-210 in BR. HANDBOOK (**3** : 313).

119 **Mergus albellus** Linnaeus (Mediterranean Sea near Smyrna) Smew **6** : 466

15 : 4 ♂♂ 7 ♀♀ 4 o ?
2 *Mesopotamia* ; 1 *Shiraz, Iran* ; 5 Sind ; 1 Gujarat ; 1 Meerut, U.P. ; 1 Monghyr, Bihar ; 3 *Peking Market*, 1 *North China.*

Among the females and unsexed specimens some appear to have smaller wings (under 180 mm.) and bills (25-26) than others (wings 180-204 ; bills 28-30). Though more of the smaller ones appear to be from the east, I cannot associate them with any character of plumage or separate areas as would permit me to suggest a subspecific separation. Larger series may perhaps be examined to advantage.

120 **Mergus merganser merganser** Linnaeus (Sweden) Goosander, Common Merganser **6** : 469

3 : 2 ♂♂ 1 ♀.
2 *Peking*, 1 *Tientsin, China.*
♂♂ wing 280-283.

*121 **Mergus merganser comatus** (Salvadori) (Native Sikkim)

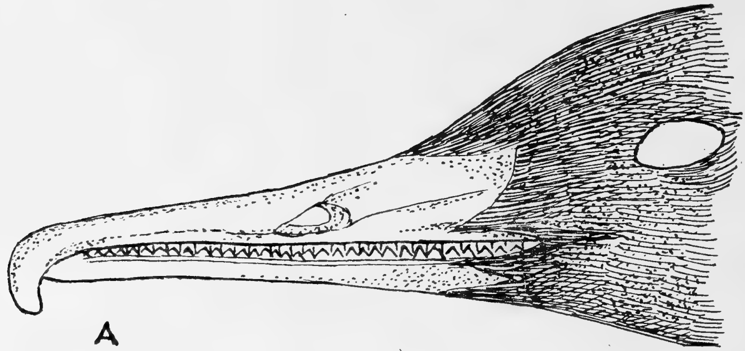
7 : 5 ♂♂ (2 by plumage) 1 ♀ *2 heads only.
*1 Dadapur, Ravi River, Punjab ; 1 Marshalong nr. Leh, 12,000′, Kashmir ; *3 Garhwal, U.P. ; 1 Gangpur, Bihar ; 1 Goalpara, Assam.

The ♂ wings 278-300 do not differ from those of the Chinese birds listed as of the nominate race, but the bills are distinctly different in shape (see sketch) and shorter. The latter is best indicated by a measurement from the notch in the feathering at the base—60-65 av. 61·4 against 68 and 69 in the others, which are also stouter.

Of the two females available, the head and the grey upper parts of the Garhwal bird are paler than those of the Chinese.

As this agrees more closely with Vaurie's version (pp. 140-142) of *comatus* rather than **orientalis* Gould (accepted in FAUNA and SYNOPSIS but which Vaurie merges with the nominate form), I am accepting the Himalayan birds as *comatus*.

The bird from the Ib River, a tributary of the Mahanadi, was shot by the Ruler of Gangpur on 31 December 1958, out of a flock of some



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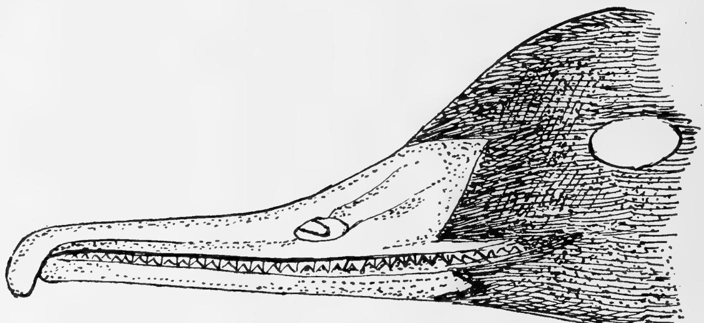

B

fifteen birds. D'Abreau, *JBNHS* **38**, p. 116, referred to one shot on the Mahanadi in the adjoining Raipur District, indicating that this species occurs further south than is generally accepted.

122 **Mergus serrator** Linnaeus (Sweden) Redbreasted Merganser **6** : 473

1 o ? No. 15598 *Ormara, Mekran*. Wing 218 (moulting) ; bill 55.

2 females of *Mergus merganser* from China and Garhwal were listed under this species. As well illustrated in BR. HANDBOOK (**3** : 337) the nostril is nearer the base of the bill than in *M. merganser* and this appears to be a useful and reliable character.

123 **Oxyura leucocephala** (Scopoli) (Probably from northern Italy) Whiteheaded Stifftailed Duck **6** : 463

16 : 3 ♂♂ 2 ♀♀ 11 o ? 1 pull.*

*1 *Bahm-i-Shur Lake, Fars, Iran* ; 1 *Kashgar, China* ; 5 Baluchistan ; 3 N.W.F.P. ; 5 Punjab ; 1 Sind.

| | Wing | | | Bill | |
|---|---|---|---|---|---|
| 3 ♂♂ | 162-164 | av.163 | (160-168) | 45-47 | av. 46 (46-49) |
| 2 ♀♀ | 157-158 | av. 157 | (150-157) | 43 (2) | (45-47) |
| 10 o ? | 150-158 | | | 42-47 | |

*(to be continued)*

# The Nilgiri Wild Life Association and Status of Wild Life in the Nilgiris

BY

E. R. C. DAVIDAR

(*With two plates*)

## INTRODUCTION

The Nilgiri Wild Life Association, for a long time known as the Nilgiri Game Association, was formed in Ootacamund in 1877 by a band of keen sportsmen, who feared that the indiscriminate shooting and fishing that was then taking place would exterminate all game and fish in the Nilgiris unless immediate action was taken. The stated objects were 'the preservation and management of the existing wild life in the Nilgiris District and the adjoining areas included under Madras Act II of 1879 and the introduction and preservation of other birds, animals and fish.' Beginning with restrictions upon themselves in the form of close seasons etc., the founders urged the Government to bring in legislation aimed at preserving game and fish. As a result, in 1879 the Government of Madras passed the Nilgiris Game and Fish Preservation Act, the first piece of legislation of its kind in India.

Almost from the start this body was associated with the regulation and management of shooting. In 1926 the management of the rainbow trout fishery, started at the Association's instance, was also entrusted to its care. And with that the Association had grown to its full stature. In the December 1939 issue of this *Journal* (**41** : 384-396), the late Lt. Col. E. G. Phythian-Adams, from whom I took over as Hon. Superintendent of the Association in 1958 and continued till January 1964, reviewed the work of the Association. In the 90th year of its existence it is time that its position is reviewed again. These notes are written with this object.

## CONSTITUTION

The holders of season shooting licences and until recently annual trout fishing licences of the Nilgiris automatically become members of the Association during the currency of their licences. On an average

there are 150 such members in a year. But with the taking over by the Government Fisheries Department of the trout fishery and the imposition of new restrictions prohibiting the issue of shooting licences to persons holding licences for other Forest Divisions in the State the membership is expected to drop to about 50. Besides, there are Honorary Members, most of them officials. The Collector of the Nilgiris is the President and the District Forest Officer, Nilgiris Division, is the Honorary Secretary. The affairs of the Association are managed by a committee consisting of not more than 24 members assisted by an Honorary Superintendent elected from among the members. Thus, although the Association is a private body, Government interests are fully protected and there is happy co-operation between officials and non-officials at the district level, which is most essential for successful wild life preservation.

## Finances

The money obtained from the scale of shooting and until recently trout fishing licences is made over to the Association by Government and is the chief source of revenue. Rent from Game Huts, boat hire charges, profits on sale of maps, etc. are the other sources. With the loss of the income from the sale of trout fishing licences, the Association's finances are in a delicate position. Fortunately the Association is in a position to exist for a decade or two on its investments.

## Activities

The Association maintains a staff of game watchers for the protection of wild life and fish and generally assists the Forest Department in the enforcement of game laws. This includes prevention of offences and detection thereof when committed. It maintains two Anti-Poaching gates in the low country[1] to prevent motor car poaching, and pays rewards for the detection of crime.

It advises on the formulation of wild life and fish preservation rules and regulations, taking into consideration local conditions.

It runs an office for the convenience of resident and tourist sportsmen, which assists in the screening and issue of licences, maintains statistics and records, and has a small library. It prepares and sells maps, issues booklets on shooting, and publishes a printed report annually.

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[1] The Nilgiris are made up of two plateaux. The upper plateau, with an elevation of 6000-8000 ft. above m.s.l., is referred to in these notes as the 'plateau', the lower plateau with an average elevation of 3000 ft. as the 'low country', and the slope between the two plateaux as the 'slopes'.

It acts as a liaison between the Forest, and Revenue Departments in this field at the district level.

The Association owns and maintains two game huts on the plateau, and plies a boat on the Mukerti Lake. It conducts census operation whenever necessary, and assists in research. It maintains a register of professional shikaris and regulates their profession. It pays rewards for the destruction of vermin, and has instituted prizes in Forest Colleges to promote the study of wild life and wild life preservation consciousness. It maintains certain tracks and approaches.

The Association represents wild life and shooting interests on the State Wild Life Board, and wild life and fish interests in the local tourists advisory committee. Its most important activity is the prevention of poaching through the activities of honorary Game Wardens and sportsmen, whose mere presence in the jungles is a deterrent to the poacher, both official and non-official. It acts generally as a watch dog in all matters connected with wild life management and preservation.

These are some of the more important of the Association's activities.

## Status of Wild Life

**Elephant.** Elephants are strictly protected and only those that are proscribed are allowed to be shot by licence holders. Such proscriptions are quite rare although about half a dozen people are killed by elephants every year. Solitary bulls raid crops and get peppered with buck shot, protection not extending to private lands, and when the wounds fester these pain-maddened beasts turn on their human tormentors. Fortunately in most cases this fit of madness passes with the healing of the wound. But solitary elephants are best avoided at all times. Elephants are found in the low country. But there have been rare cases of stragglers visiting the plateau by the Sispara Pass for very brief periods. As regards its status, there are more elephants now than there were 2 to 15 years ago, probably more than at any time before in living memory. Not all this increase is due to migrations from Mysore and Kerala as some people believe. The number of calves in each herd would show that there is really an explosion of elephant population. Unless some thing is done to check their numbers the Nilgiri elephants are going to make themselves a thorough nuisance.

**Gaur.** Confined to the low country and the slopes. Gaur are on the increase. The country around Mudumalai in the Sanctuary being more favourable, more are found there. Shootable bulls, that is bulls whose horns have a span of 33 inches and above or a girth of 18 inches and above, are not easy to find in the shooting area except on the difficult slopes.

There are some herds on the southern slopes both above and below Mettupalayam which falls within the area covered by the Nilgiris game licence. With the loss of shooting territory around Mudumalai efforts are being made to popularise this area to shooting and thus better preserve the wild life in the area. Already these efforts are bearing fruit.

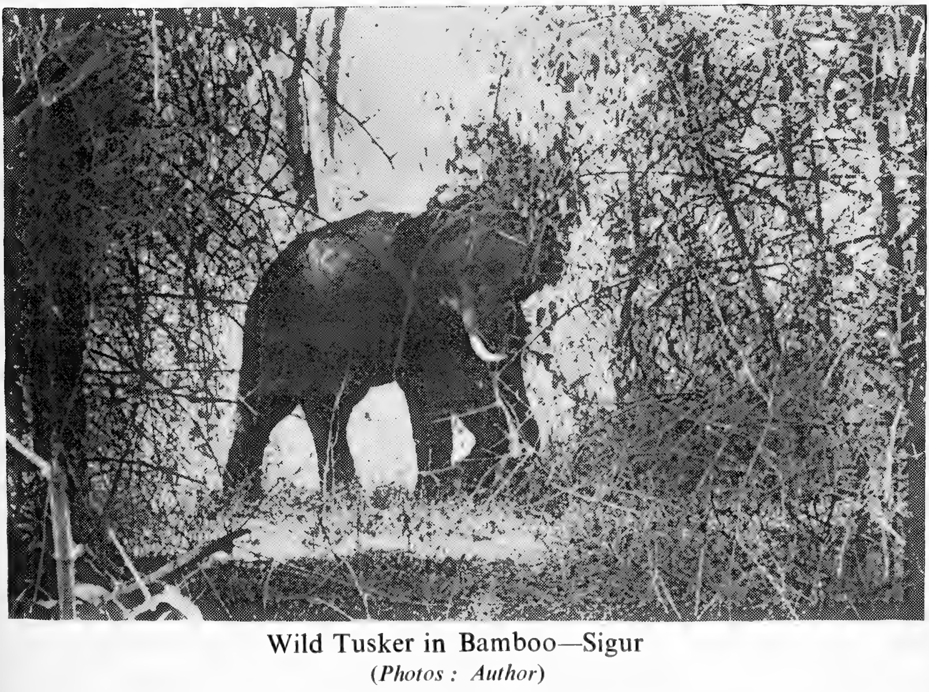
**Sambar.** Writing in the December 1939 issue of the *Journal* Lt. Col. Phythian-Adams, wrote : ' Though a fair number are to be found in the low country the great majority are on the plateau where they have so increased in spite of ravages of tigers, panthers, and wild dogs. . . .'. Alas, the position of the sambar on the plateau is far from satisfactory today. Except in a few pockets where there are between half a dozen to a dozen animals, the sambar is very scarce. Estate labour with dogs killed quite a few. But poachers could not have accounted for all the missing sambar, for poaching never get out of hand in the Nilgiris as in the other districts. How they could have disappeared even from areas where no poaching took place is a mystery. However, it is comforting to know that there are more sambar on the plateau today than there were a few years ago. As soon as there is an appreciable increase, wild dogs invade the plateau from the low country in numbers and bring down the population. In 1960 there was such an invasion and in one bay of the Pykara Lake alone 14 sambar skulls were recovered. It is hoped that the new wattle plantations of the Forest Department on the plateau will provide more cover for the sambar and help it to some extent to make a come back. But this would depend upon the extent of grassland left for it to feed upon. In the low country sambar are definitely on the increase. But shootable herds continue to be shy and come out late in the evening and retire before dawn, when they cannot be legitimately shot.

A $44\frac{1}{2}$-incher, a record for the Nilgiris, was shot on the plateau in 1952.

The bag limit on an annual licence has been further reduced from two to one. The size limit remains at 28 in.

**Chital.** This species has recorded a spectacular increase. Herds of a hundred or more are not uncommon. In 1939 Lt. Col. Pythian-Adams wrote : ' The great majority of the stags shot come from the Mudumalai Forest '. Mudumalai is now in the heart of the wild life sanctuary of that name, but the concentration has moved east and large herds are now found around Masinigudi and Anaikatty. Stags with antlers of 35 in. and 36 ins. are obtained every year. 37 in. and 38 inches are by no means rare. This shows that the chital has improved not only in numbers but in quality also. Until about the end of the last century a $32\frac{1}{2}$ in. head was considered a prize (*vide* SPORT ON THE

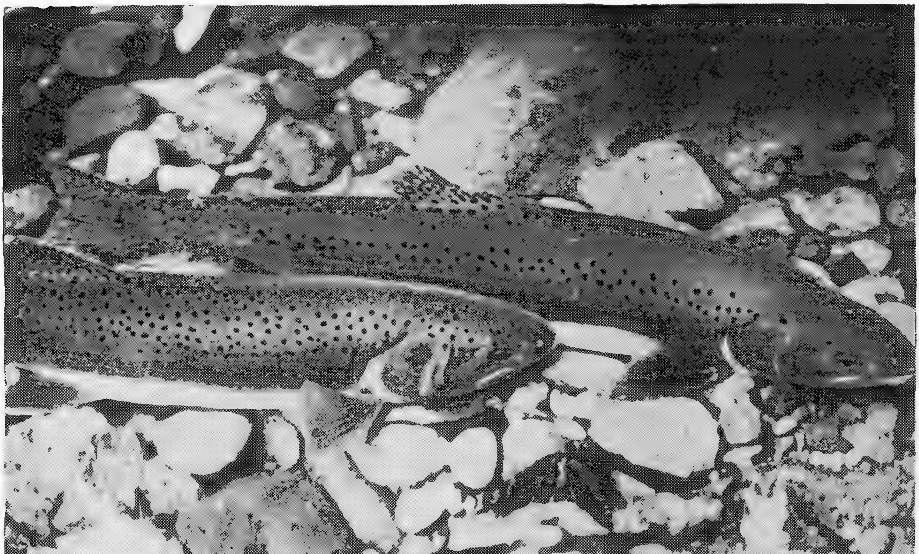
Solitary bull Gaur—Mudumalai



Wild Tusker in Bamboo—Sigur
(*Photos: Author*)

Davidar: Nilgiri Wild Life Association

Herd of Nilgiri Tahr—Bangitappal



Nilgiri Rainbow Trout on spawning bed—Avalanche

(*Photos : Author*)

NILGIRIS by F. W. F. Fletcher). A close season is observed between June and October and, during part of the open season, many of the stags are in velvet and cannot be shot. Two stags are allowed on an annual licence, but to prevent over-shooting the rule imposes a 30-day interval between the shooting of the 1st and the 2nd stag. Some culling may have to be done in the not distant future by sacrificing a few old does periodically in the larger interests of the species.

**Nilgiri Tahr.** The 1963 census (*vide* April 1963 issue of the *Journal*) revealed that there are not less than 300 animals living on the cliffs along the western face of the plateau. This stock was built from the few that were left at the end of the last century.

Only ' saddle backs ' are allowed to be shot and their numbers vary from year to year. No spectacular heads have been obtained in recent years.

Roads have been formed under the Kundah Hydro-Electric Scheme right in the heart of the tahr country and thousands of workmen are living and working on the scheme in places where the tahr was the sole inhabitant. This is only a passing phase. After the project is completed only a skeleton maintenance staff will remain and peace will return. But the real danger to the tahr lies in the wattle and bluegum plantations of the Forest Department which are spreading their tentacles far and wide and in many places right up to the verge of the cliffs. Depriving the tahr of its feeding grounds will certainly not be in the interests of the preservation of the animal. The Association has been trying hard for the reservation of a belt of grass along the cliff line, but the assurances given to it are repeatedly broken. The future of the tahr will depend upon what is left to it to eat.

**Blackbuck.** There were not many of these antelopes at any time. In 1951 a state-wide ban was placed on the shooting of these animals. Once the sportsmen lost interest even the few that were left vanished from their old haunts around Masinigudi, Moyar and Kargudi. Being partial to cultivation they must have fallen victims to the crop protection gun. A few are said to lead a precarious existence in the scrub jungle between the Bhavani and Moyar Rivers above the Bhavanisagar Reservoir. Here is a species which could be and ought to be reintroduced.

**Barking Deer.** This deer locally known as the ' jungle sheep ', is more partial to the plateau than to the low country. The conditions on the plateau are so unsettled because of the work on the Kundah Hydro Electric Project and the extensive wattle plantations of the Forest Department that these deer venture out of the security of the sholas only late in the evening thus making it difficult to assess their

status. The cover provided by the new wattle plantations it is hoped will help the barking deer to propagate its species provided enough grassland is left unencroached. It is doubtful if this will be done.

The bag limit has been further reduced to two on an annual licence and to one on a monthly licence.

**Four-horned Antelope.** The few that occur in the low country are found chiefly in the light jungle above the Moyar Canyon. They are now protected. One of their enemies is the 'sportsmen' who cannot distinguish between the four-horned antelope and the barking deer !

**Tiger.** With the depletion of the vast sambar population on the plateau and on account of the disturbed conditions prevailing there few tigers are resident on the plateau. In the low country they are maintaining their strength. The vast area of sanctuary and the temporary protection now afforded them throughout the district there ought to be more tigers. In fact this does not appear to be the case although poisoning of tigers is not practised on a large scale. There have been only a few suspected cases. Particularly in the case of the larger canivore unless a realistic policy is adopted the 'protection' afforded them is likely to act to their detriment. Payment of compensation during the closed period would be a right step in this direction.

Nilgiri Tigers have a deeper coat and are prettier. Except for a very heavy tiger shot a few years ago there is no record of outsize tigers.

Tigers, panthers, and bears were classed as 'game' only recently. The shooting of these animals is now prohibited altogether.

**Panther.** There are more panthers in the low country than on the plateau. But they are by no means numerous and are very elusive. Black panthers are seen occasionally.

**Bear.** As in the case of gaur, the best bear country falls within the sanctuary and those that are in the shooting area live in difficult country along the slopes and are rarely met with during the day.

**Hyena.** These animals are not classified as game. Except for a few stragglers on the plateau hyenas mainly occur in the low country around Masinigudi and Anaikatti. Even there they are not numerous and are seldom seen except at 'kills'.

**Pig.** The pig population fluctuates. For some years they go on increasing then for some unknown reason their numbers go down. They are equally at home in the low country as well as on the plateau. They are also not classified as game and consequently there is no bag limit.

**Wild dog.** This animal seldom takes up permanent residence on the plateau. Some years they do not visit the plateau at all. They are

numerous in the low country and do considerable damage living mostly on young deer.

**Small game.** There are fewer jungle fowl in the plateau today chiefly because the natural sholas are either being destroyed or replaced with bluegum and wattle plantations. Some of the famous wood-pigeon sholas have also vanished. So far as the winter visitors namely woodcock and snipe are concerned there has been no appreciable change. But with the exodus of the resident European sportsmen who were chiefly interested in small game there are fewer pursuers of game birds now.

In the low country hare and jungle-fowl have increased as compared with a few years ago. Peafowl have registered a larger increase.

## Problems Facing Wild Life

Among the many problems faced by wild life, indiscriminate slaughter on and around private lands continues to be the gravest.

Next on the list are the arm-chair conservationist and the unrealistic policy of the Government in closing of forests to shooting to placate him without affording special protection to wild life in the area resulting in wholesale slaughter.

Disturbed conditions prevailing in the various hydro-electric project areas, population pressures, increasing demands made on forest lands, denudation of forests, disturbance of natural conditions and forests by the planting of bluegum wattle and other such exotics on a massive scale, use of insecticides and pesticides, harmful to wild life, excessive cattle grazing and consequent soil erosion, and better transport facilities have not been conducive to the preservation and propagation of wild life. In spite of these handicaps wild life in the Nilgiris has not done too badly and in the case of certain species has shown a marked increase thanks to the wild life preservation consciousness and sportsmanship roused by the Association.

## Fishing

Experiments in trout culture began as early as 1863 and continued at great expense to the Association and to private persons. But until 1906 when on the suggestion of the Association, the services of Mr. H. C. Wilson as Fish Conservator were obtained from Ceylon, it was still in the experimental stage. Mr. Wilson introduced the rainbow trout in preference to the brown trout and, in 1909, built a hatchery at Avalanche for its culture. By 1911 he had placed the Nilgiri trout fishery on a sound footing.

In 1926 the Association resumed control of the trout fishing on the plateau and managed it till 1965. It discontinued running the hatchery in 1956 as by that time every trout stream was overstocked with small trout. The main problem then was finding food for the trout.

Since then the conditions have changed. With the implementation of the Kundah Hydro-Electric Scheme and the extension of the Pykara Hydro-Electric Project almost all the trout streams have been dammed or are in the process of being dammed. The miles of spawning beds in every stream are now deep down under water and are useless and artificially hatched out and bred trout have assumed importance once more. As the Association could not run the hatchery with its slender resources it was made over to the Government Fisheries Department in 1958. A modern hatchery with a larger capacity is necessary if the trout fishery is to remain an attraction.

With the changed conditions the pattern of fishing has also changed. Fly fishing which was the only authorised method of fishing is being replaced by spinning. Wet-fly fishing is practised or rather anglers are compelled to practise this art in the few streams that are left and in the upper reaches of reservoirs.

For the first few years after each dam is built water backing up behind the dam floods fields and forests and thus provides more food for the trout and helps it to put on weight rapidly. It is then that the sport is at its best. But, once the food supply is exhausted, the fish start going back, and the loss of spawning grounds soon starts telling upon their numbers as well.

The Fisheries Department's idea of the introducing mirror carp into every likely water would have ruined the trout fishery altogether had not the Association got the Government to agree to the reservation of certain top level reservoirs exclusively for trout.

Every summer the reservoirs are almost drained dry and many trout are lost in this manner.

To compensate for the lost trout streams, the Association successfully introduced trout into every stream on the plateau capable of holding trout.

As in the case of game preservation, fish is also best preserved by associating anglers in the management of the fishery, particularly in a delicate sport fishery like the trout fishery which cannot stand much abuse. What the Association achieved with the expenditure of a few thousand rupees the Fisheries Department is unable to do in spite of spending enormous sums of money.

## Conclusion

The experiment in associating the sporting public through the Association in wild life and fish preservation and preservation through well-regulated shooting and fishing has proved an immense success as a survey of the wild life and trout position in the Nilgiris as compared to other similar areas in south India would show.

Unless the problems facing the Association and wild life and fish preservation are appreciated and timely assistance rendered, the future for both is none too bright.

TABLE 1

BIG GAME SHOT BETWEEN THE YEARS 1940-1966

| Year | Gaur | Sambar | Chital | Nilgiri Tahr | Black Buck | Tiger | Panther | Bear | Barking Deer | 4-Horned Antelope | Licences Season | Licences Monthly | Licences Weekly Big Game | Licences Weekly Small Game | Licences Daily Small Game |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1940-42 .. | 6 | 17 | 13 | 8 | 1 | 5 | 6 | 1 | 35 | .. | 46 | 6 | 2 | 7 | .. |
| 42-43 .. | 8 | 9 | 8 | 3 | .. | 9 | 3 | .. | 9 | .. | 60 | 27 | 20 | 31 | 21 |
| 43-44 .. | 3 | 25 | 18 | 2 | .. | 5 | 6 | 2 | 23 | .. | 62 | 44 | 38 | 27 | 25 |
| 44-45 .. | 5 | 18 | 15 | 1 | 1 | 4 | 2 | 1 | 19 | .. | 71 | 51 | 67 | 22 | 12 |
| 45-46 .. | .. | 7 | 4 | 1 | 2 | 3 | 4 | .. | 28 | .. | 86 | 46 | 47 | 25 | 36 |
| 46-47 .. | 1 | 10 | 11 | 3 | .. | 1 | 6 | 2 | 23 | .. | 101 | 40 | 50 | 11 | 49 |
| 47-48 .. | 1 | 9 | 6 | 3 | 1 | 2 | 4 | 1 | 23 | 1 | 109 | 21 | 21 | 7 | 17 |
| 48-49 .. | 2 | 9 | 15 | 2 | C | 10 | 8 | .. | 34 | .. | 100 | 25 | 13 | 7 | 6 |
| 49-50 .. | 5 | 9 | 9 | 1 | C | 6 | 12 | 1 | 57 | 1 | 99 | 17 | 9 | 4 | 2 |
| 50-51 .. | 7 | 9 | 17 | 2 | C | 6 | 10 | .. | 38 | 1 | 129 | 20 | 10 | 11 | 7 |
| 51-52 .. | 4 | 13 | 16 | 2 | C | 5 | 8 | 1 | 40 | .. | 106 | 16 | 17 | 4 | 8 |
| 52-53 .. | 1 | 4 | 5 | 2 | C | 2 | 7 | .. | 30 | .. | 89 | 23 | 9 | 11 | 12 |
| 53-54 .. | .. | 7 | 11 | .. | C | 5 | 4 | .. | 8 | 1 | 82 | 6 | 8 | 3 | 13 |
| 54-55 .. | 5 | 3 | 10 | 1 | C | 3 | 4 | .. | 12 | .. | 81 | 20 | 13 | 4 | 8 |
| 55-56 .. | 4 | 5 | 21 | 1 | C | 7 | 6 | .. | 16 | C | 101 | .. | 4 | 4 | .. |
| 56-57 .. | 1 | 7 | 16 | 5 | C | 3 | 5 | 2 | 29 | C | 110 | .. | .. | .. | .. |
| 57-58 .. | 3 | 3 | 22 | .. | C | 5 | 3 | 1 | 32 | C | 110 | 14 | .. | 4 | .. |
| 58-59 .. | 2 | 7 | 28 | 2 | C | 6 | 1 | 1 | 32 | C | 97 | 18 | .. | 5 | .. |
| 59-60 .. | 2 | 5 | 49 | 6 | C | 4 | .. | 3 | 27 | C | 107 | 22 | .. | 1 | .. |
| 60-61 .. | .. | 6 | 54 | 1 | C | 6 | 3 | .. | 16 | C | 109 | 32 | .. | 6 | .. |
| 61-62 .. | 3 | 12 | 46 | .. | C | .. | 1 | 1 | 12 | C | 123 | 25 | .. | 6 | .. |
| 62-63 .. | 2 | 14 | 38 | 3 | C | 4 | 6 | 1 | 20 | C | 115 | 20 | .. | 8 | .. |
| 63-64 .. | .. | 10 | 32 | 3 | C | 5 | 6 | C | 13 | C | 111 | 20 | .. | 2 | .. |
| 64-65 .. | 4 | 9 | 30 | 2 | C | C | C | C | 8 | C | | | | | |
| 65-66 .. | 1 | 9 | 48 | 4 | C | C | C | C | 7 | C | | | | | |

NOTE. C=closed.

TABLE II

SMALL GAME SHOT BETWEEN THE YEARS 1939-1966

| YEAR | Jungle cock | | Jungle hen | | Spur-fowl | | Snipe | | Wood Pigeon | | Hare | | Wood-cock | Mouse Deer | Pea-cock | Pea-hen | Par-tridge | Quail |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plateau | Low Country | Plateau | Low Country | Plateau | Low Country | Plateau | Low Country | Plateau | Low Country | Plateau | Low Country | Plateau | Low Country | Low Country | Low Country | Low Country | Low Country |
| 1939-40 | 159 | 207 | C | 254 | 23 | 85 | 582 | 146 | 240 | 344 | 110 | 164 | 138 | 2 | 97 | C | 97 | 1 |
| 40-42 | 97 | 295 | C | 240 | 12 | 97 | 649 | 115 | 238 | 151 | 46 | 121 | 115 | 3 | 117 | 19 | 87 | 2 |
| 42-43 | 112 | 191 | C | 207 | 41 | 92 | 402 | .. | 375 | 78 | 109 | 109 | 126 | 7 | 69 | 39 | 120 | 24 |
| 43-44 | 145 | 128 | 40 | 107 | 29 | 38 | 515 | 8 | 302 | 63 | 51 | 87 | 117 | 2 | 43 | 27 | 33 | 16 |
| 44-45 | 128 | 34 | 54 | 25 | 14 | 7 | 153 | 10 | 191 | 84 | 39 | 47 | 31 | 2 | 5 | 3 | 29 | .. |
| 45-46 | 154 | 81 | 119 | 62 | 37 | 14 | 283 | .. | 234 | 81 | 80 | 39 | 73 | 1 | 14 | 13 | 42 | 21 |
| 46-47 | 159 | 55 | 108 | 45 | 54 | 7 | 595 | .. | 238 | 46 | 72 | 33 | 7 | 7 | 20 | 14 | 40 | 18 |
| 47-48 | 138 | 138 | 103 | 124 | 62 | 33 | 167 | 4 | 316 | 44 | 93 | 71 | 68 | 12 | 18 | 28 | 45 | 31 |
| 48-49 | 147 | 136 | 133 | 114 | 83 | 26 | 252 | 53 | 216 | 57 | 124 | 82 | 89 | 21 | 56 | 33 | 58 | 59 |
| 49-50 | 200 | 116 | 115 | 87 | 58 | 26 | 346 | 116 | 465 | 4 | 155 | 44 | 124 | 13 | 28 | 43 | 76 | 37 |
| 50-51 | 174 | 116 | 151 | 77 | 56 | 20 | 244 | 30 | 362 | 14 | 200 | 28 | 81 | 22 | 39 | 13 | 53 | 45 |
| 51-52 | 180 | 119 | 170 | 116 | 69 | 35 | 180 | .. | 240 | 87 | 188 | 55 | 71 | 24 | C | C | 75 | 38 |
| 52-53 | 93 | 70 | 60 | 107 | 85 | .. | 286 | 134 | 413 | 83 | 74 | 32 | 85 | 23 | C | C | 75 | 35 |
| 53-54 | 122 | 59 | 69 | 52 | 45 | .. | 216 | 34 | 186 | 33 | 77 | 70 | 45 | 10 | C | C | 46 | 42 |
| 54-55 | 55 | 103 | 43 | 51 | 26 | 15 | 232 | 58 | 171 | 17 | 42 | 47 | 53 | 20 | C | C | 33 | 6 |
| 55-56 | 87 | 59 | 48 | 39 | 33 | 25 | 98 | 68 | 81 | 27 | 53 | 22 | 55 | 18 | C | C | 19 | 9 |
| 56-57 | 98 | 48 | 73 | 49 | 24 | 18 | 132 | 92 | 112 | 27 | 80 | 43 | 54 | 19 | C | C | 12 | 18 |
| 57-58 | 107 | 42 | 65 | 44 | 31 | 12 | 190 | 78 | 221 | 10 | 47 | 27 | 73 | 10 | C | C | 14 | 17 |
| 58-59 | 132 | 75 | 64 | 54 | 32 | 32 | 42 | 5 | 257 | 49 | 85 | 26 | 86 | C | C | C | 29 | 6 |
| 59-60 | 100 | 56 | 54 | 27 | 30 | 10 | 89 | 115 | 187 | 70 | 74 | 48 | 79 | C | C | C | 43 | 23 |
| 60-61 | 87 | 82 | 56 | 76 | 14 | 37 | 63 | 219 | 113 | 40 | 73 | 83 | 55 | C | C | C | 54 | 5 |
| 61-62 | 67 | 94 | 25 | 59 | 16 | 15 | 57 | 309 | 86 | 14 | 73 | 38 | 49 | C | C | C | 27 | 2 |
| 62-63 | 61 | 81 | 29 | 86 | 7 | 33 | 20 | 212 | 156 | 5 | 62 | 45 | 36 | C | C | C | 43 | 2 |
| 63-64 | 77 | 125 | 40 | 129 | 7 | 42 | 49 | 307 | 157 | 23 | 39 | 85 | 50 | C | C | C | 27 | 32 |
| 64-65 | 74 | 80 | 31 | 80 | 15 | 26 | 18 | .. | 81 | 30 | 48 | 42 | 22 | 3 | C | C | 29 | 13 |
| 65-66 | 54 | 52 | 36 | 60 | 10 | 22 | 11 | .. | 52 | 14 | 46 | 30 | 10 | 3 | C | C | 24 | 20 |

C=closed.

TABLE III

VERMIN DESTROYED AND OFFENCES REPORTED BETWEEN THE YEARS 1939-1964

VERMIN DESTROYED

| Year | Wild dog | Wild cat | Red Mongoose | Grey Mongoose | Crow Pheasant | Sparrow hawk | Harrier | Eagle Owl | Offences reported | Shooting | Fishing |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1939-40 | 38 | 13 | 7 | .. | 14 | .. | .. | .. | .. | | |
| 40-42 | 37 | 10 | 4 | .. | 17 | .. | 2 | .. | .. | 8 | 3 |
| 42-43 | 11 | 4 | 3 | .. | 66 | .. | 16 | | | 11 | 4 |
| 43-44 | 18 | 2 | .. | .. | 46 | 1 | .. | .. | .. | 5 | 2 |
| 44-45 | 9 | 1 | .. | .. | 8 | 2 | 3 | .. | .. | 9 | 7 |
| 45-46 | 20 | 9 | 3 | 5 | 7 | .. | .. | .. | 10 | 17 | 2 |
| 46-47 | 10 | 6 | 5 | 5 | 11 | 1 | .. | 3 | 6 | 20 | 3 |
| 47-48 | 13 | 9 | 5 | 15 | 27 | .. | .. | 2 | 2 | 17 | .. |
| 48-49 | 14 | 22 | 11 | 23 | 72 | 4 | 1 | 6 | 2 | 9 | 1 |
| 49-50 | 17 | 34 | 26 | 21 | 49 | 1 | .. | 1 | 7 | 3 | .. |
| 50-51 | 16 | 53 | 9 | 8 | 19 | 1 | 1 | 2 | 5 | 8 | 1 |
| 51-52 | 12 | 23 | 2 | 17 | 24 | 1 | 1 | 1 | 1 | 3 | .. |
| 52-53 | 2 | 26 | 15 | 6 | 18 | .. | .. | .. | 3 | 8 | 1 |
| 53-54 | 5 | 30 | 11 | 15 | 30 | .. | 2 | .. | .. | 6 | 2 |
| 54-55 | 6 | 23 | 6 | 27 | 23 | 1 | 5 | 3 | 5 | 8 | .. |
| 55-56 | 3 | 36 | 12 | 8 | 52 | 2 | 8 | 6 | 4 | 7 | 1 |
| 56-57 | 20 | 38 | 12 | 22 | 36 | 2 | 6 | 5 | 5 | 8 | 7 |
| 57-58 | 6 | 40 | 9 | 26 | 52 | 1 | 2 | 4 | 2 | 8 | 12 |
| 58-59 | 9 | 12 | 8 | 11 | 27 | 2 | 2 | 2 | .. | 7 | 16 |
| 59-60 | 10 | 32 | 4 | 7 | 15 | .. | .. | 1 | 6 | 7 | 10 |
| 60-61 | 11 | 15 | 3 | 6 | 6 | 1 | 1 | .. | .. | 14 | 12 |
| 61-62 | 6 | 19 | 3 | 5 | 4 | .. | .. | 3 | .. | 12 | 14 |
| 62-63 | 7 | 8 | 1 | 1 | 4 | .. | .. | 5 | 2 | 11 | 42 |
| 63-64 | 9 | 23 | 3 | 5 | 60 | 6 | .. | 3 | .. | 3 | 18 |

POACHING AND VERMIN

Poaching can never be rooted out entirely. But the existence of the Association and the activities of its members and staff and, of course, the Forest and Fisheries staff help to keep it within bounds. Poaching by licence-holders and officials is not as serious as in other districts. Motor car poaching has been brought under control since the erection of the anti-poaching gates. Poaching cases are dealt with through the Forest Department and the courts. In deserving cases rewards are paid.

Rewards are paid for the destruction of vermin and their numbers are thus kept in check.

TABLE IV

FISHING RETURNS BETWEEN THE YEARS 1939-1964

| Year | Trout killed | 1 lb. or over | 2 lbs. or over | 3 lbs. or over | 4 lbs. or over | 5 lbs. or over | Put back (Re-turned) |
|---|---|---|---|---|---|---|---|
| 1939-40 | 3847 | 321 | 82 | 6 | .. | .. | 1870 |
| 40-41 | 4237 | 220 | 30 | 1 | .. | .. | 2268 |
| 41-42 | 5392 | 213 | 20 | .. | .. | .. | 2943 |
| 42-43 | 4578 | 229 | 24 | .. | .. | .. | 2693 |
| 43-44 | 5269 | 291 | 47 | 5 | .. | .. | 2082 |
| 44-45 | 3202 | 202 | 64 | 5 | .. | .. | 3125 |
| 45-46 | 4112 | 215 | 38 | 8 | .. | .. | 3648 |
| 46-47 | 4010 | 156 | 21 | .. | .. | .. | 2811 |
| 47-48 | 5366 | 216 | 24 | 3 | .. | .. | 2911 |
| 48-49 | 2869 | 244 | 23 | 2 | .. | .. | 1278 |
| 49-50 | 3493 | 141 | 8 | .. | .. | .. | 756 |
| 50-51 | 2655 | 146 | 18 | 3 | .. | .. | 587 |
| 51-52 | 2950 | 102 | 7 | .. | .. | .. | 1118 |
| 52-53 | 2563 | 88 | 4 | 2 | .. | .. | 515 |
| 53-54 | 1972 | 108 | 5 | .. | .. | .. | 423 |
| 54-55 | 1985 | 143 | 23 | 11 | .. | .. | 732 |
| 55-56 | 1432 | 141 | 35 | 27 | 12 | .. | 473 |
| 56-57 | 1973 | 146 | 56 | 32 | 17 | 11 | 771 |
| 57-58 | 3801 | 75 | 50 | 5 | 2 | .. | 1547 |
| 58-59 | 2505 | 67 | 34 | 4 | 1 | .. | 1449 |
| 59-60 | 2812 | 82 | 11 | 4 | .. | 1 | 1417 |
| 60-61 | 2573 | 143 | 29 | 19 | 11 | 9 | 1703 |
| 61-62 | 2153 | 184 | 76 | 45 | 24 | 8 | 1362 |
| 62-63 | 2613 | 421 | 78 | 40 | 13 | 5 | 1542 |
| 63-64 | 1583 | 211 | 52 | 10 | .. | 2 | 1090 |

# On the relation between age and linear measurements of the Pearl Oyster, *Pinctada vulgaris* (Schumacher), of the Gulf of Kutch

BY

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(*With four text-figures*)

## Introduction

The coral reefs along the northern coast of Jamnagar District, Gujarat State, yield good quantities of Mother of Pearl Oysters. Their systematics have not been worked out in detail so far, but they have been provisionally identified as *Pinctada vulgaris* (Schumacher), which name is used in this paper. Regular pearl fisheries have been conducted in the area and records are available from the year 1913. The authors are not aware of detailed investigations on the oysters from this locality except by Gokhale *et al.* (1954), who studied the age, growth rate and approximate age of pearl formation. In the present study an attempt is made to relate the age of the oysters (as represented by the annual growth rings) with the linear measurements, like length, breadth, hinge length, thickness, and hinge width and to examine the dependability of these measurements in assessing the age of the oysters.

## Previous Work

Hornell (1922) found that ' the growth rate of the Indian oysters is distinctly retarded after the third year, the life conditions being more favourable to the young than the old ', and that ' the hinge line is shallow at first but with increasing age, becomes deeper and gutter-like '. ' Its depth and width are our best indications of the age of the oyster '. Cahn (1949) reports that Yamagouchi working on the developmental history of the Japanese Pearl Oyster, *Pinctada martensii* observed that the growth rate is fast up to the fourth year, after which it is retarded. Devanesan & Chidambaram (1956) also observed that the rate of increase in the

measurements is great in the young oysters and decreases with age and that the number of growth rings cannot be accepted as a key for determining the age of the oysters, as ' these concentric curving lines are too closely set in the young and are generally abraded in the adult '. However, Rao (1951) had used such rings in ascertaining the age of *Katelysia opima* (Gmelin). According to him, the rings are ' disturbance rings, caused by the cessation of growth, which may be due to drop of salinity of sea water '. Gokhale *et al.* (1954) found that the rings are formed annually on the shells of the oysters and hence used them as indicators of age of oysters and that the thickness gave more consistent data than other measurements. Though Hornell (1922) had recommended the use of hinge width and hinge depth measurements in aging oysters, these two measurements, it appears, have not been studied by other authors excepting Tranter (1958), who observed that the Australian Pearl Oyster, *Pinctada albina* (Lamarck), attained maturity at a heel depth of 0·5 mm. Alagaraja (1962) studied the length-weight relation of pearl oysters of the Gulf of Mannar but has not indicated the relationship between age and thickness or hinge.

## Materials and Methods

The material used is the data on length, breadth, hinge length, hinge width, thickness, and the growth rings of pearl oysters reared in the Pearl Oyster Park and the sea-water tank at Sikka, by the Department of Fisheries, Gujarat State. In addition, measurements of about a thousand oysters collected at random during the survey conducted by the Fisheries Research Station, Government of Gujarat, Jamnagar, in 1964, have also been incorporated.

The authors have followed the terminology, as adopted by Devanesan & Chidambaram (1956) Length is the actual depth of the animal

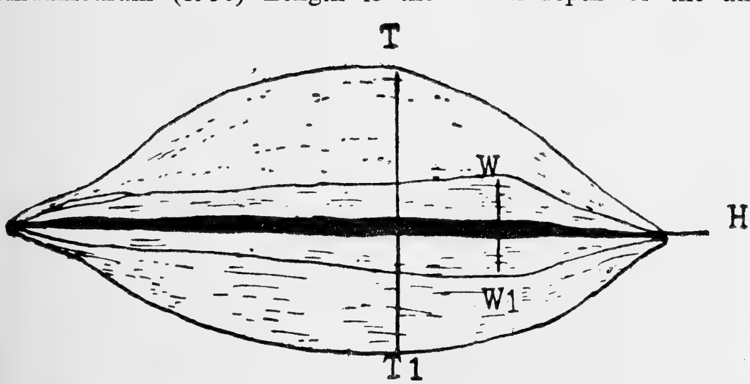



Fig. 1 H : Hinge ; T-T1 ; Thickness ; W-W1 ; Hinge width.

and indicates the longest distance between the hinge line and the outer margin of the valves. Breadth is the maximum distance, along the

antero-posterior axis of the body and corresponds to the actual length of the animal. Thickness, the maximum distance between the external surfaces of the two valves. The hinge length is the actual length of the animal along the hinge line, and the hinge width, the maximum distance between the edges of the two valves at the hinge (Fig. 1).

The measurements, excepting hinge width, were measured with vernier callipers and the hinge width with a pair of dividers. All linear measurements are in millimetres.

## Data analysis

The weighed mean of the length, breadth and hinge length of the valves were worked out age-wise and are shown in Table 1.

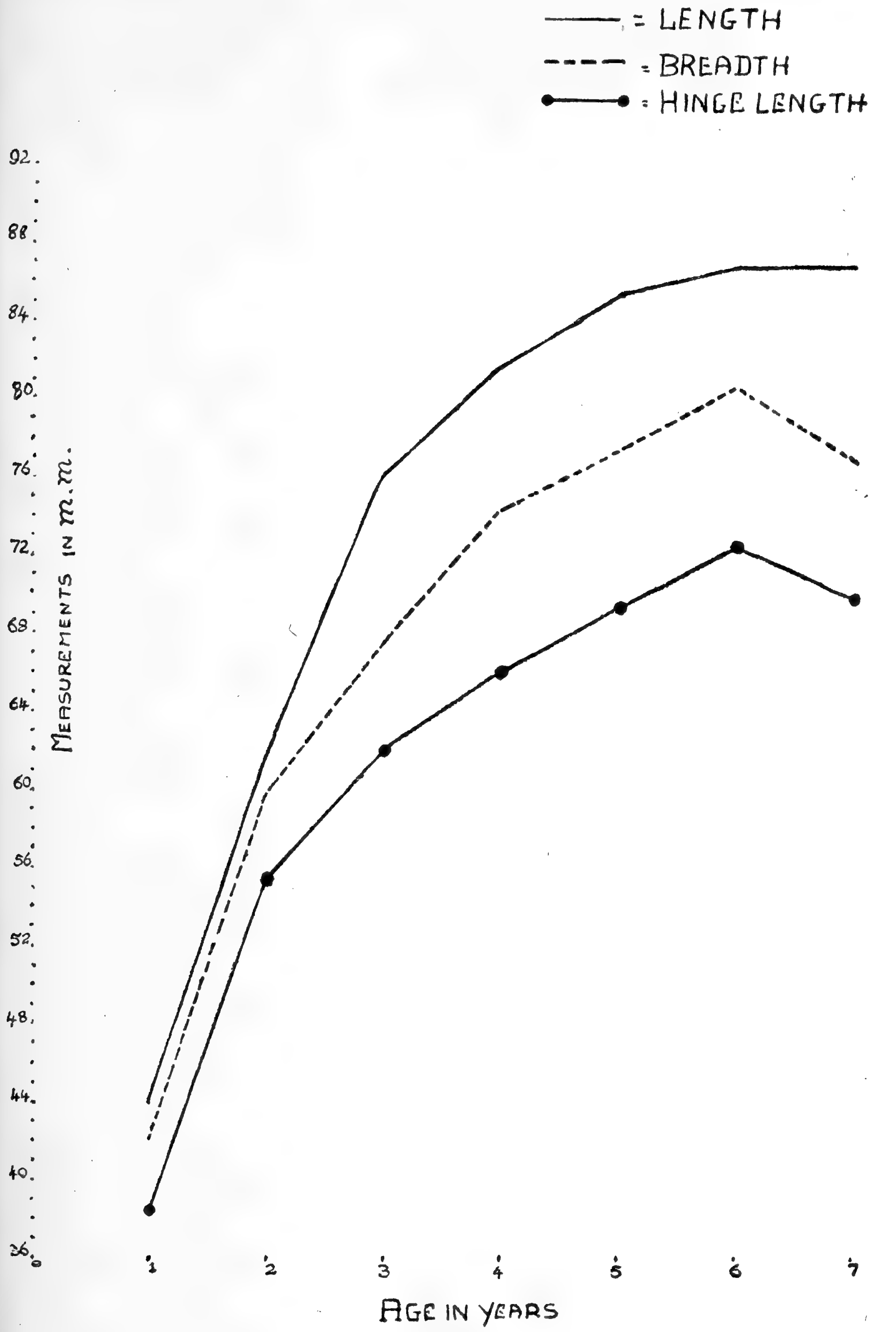
Table 1

| Age in years | Length | Breadth | Hinge length |
|---|---|---|---|
| 1 | 44·05 | 42·14 | 38·42 |
| 2 | 61·68 | 58·93 | 55·45 |
| 3 | 76·20 | 67·66 | 62·00 |
| 4 | 81·62 | 74·32 | 66·09 |
| 5 | 85·15 | 77·35 | 69·37 |
| 6 | 86·65 | 80·50 | 72·44 |
| 7 | 86·67 | 76·70 | 69·84 |

It is apparent from the table that the length, breadth and the hinge length increase with age. The rate of increase is rapid up to the third year, but retarded subsequently and is negligible after the sixth year. This might be due to the lessening of the metabolic rate of the animal with increasing age (Fig. 2). These observations agree generally with those of Hornell (1922), Cahn (1949), Devanesan & Chidambaram (1956) and Gokhale *et al.* (1954). However, Hornell's contention that the lessening of the rate of growth is due to encrustations has not been accepted by Gokhale *et al.* (1954). Our observations support the views of the latter since the oysters studied were periodically checked and cleaned of encrustations at regular intervals.

The thickness and hinge width were correlated with the annual growth rings, as shown in Tables 2 and 3.

As can be seen from Table 4, the age-wise increase in thickness and hinge width are more or less uniform, though not constant (Figs. 4 and 5). There is no retardation in the increase of these measurements at any particular stage, unlike in length, breadth and hinge length.



= LENGTH
= BREADTH
= HINGE LENGTH
92
88
84
80
76
72
68
64
60
56
52
48
44
40
36
MEASUREMENTS IN m.m.
1
2
3
4
5
6
7
AGE IN YEARS


Fig. 2

TABLE 2

CORRELATION BETWEEN AGE AND THICKNESS

| Thickness | Number of oysters of the age group | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| 19 | 11 | — | — | — | — | — | — | 11 |
| 20 | 30 | — | — | — | — | — | — | 30 |
| 21 | 64 | 29 | — | — | — | — | — | 93 |
| 22 | 51 | 60 | — | — | — | — | — | 111 |
| 23 | 15 | 30 | 26 | — | — | — | — | 71 |
| 24 | 12 | 15 | 32 | — | — | — | — | 59 |
| 25 | 9 | 50 | 41 | 40 | — | — | — | 140 |
| 26 | 8 | 12 | 75 | 41 | 15 | — | — | 151 |
| 27 | 2 | 11 | 51 | 34 | 16 | — | — | 114 |
| 28 | 5 | 7 | 49 | 32 | 25 | — | — | 118 |
| 29 | — | 6 | 30 | 25 | 19 | 12 | — | 92 |
| 30 | — | — | 26 | 24 | 27 | 15 | 24 | 116 |
| 31 | — | — | 15 | 18 | 28 | 13 | 12 | 86 |
| 32 | — | — | 8 | 8 | 18 | 9 | 9 | 52 |
| 33 | — | — | 1 | 4 | 15 | 7 | 16 | 43 |
| 34 | — | — | — | — | 11 | 6 | 20 | 37 |
| 35 | — | — | — | — | 6 | 5 | 13 | 24 |
| 36 | — | — | — | — | — | 5 | 12 | 17 |
| 37 | — | — | — | — | — | 6 | 9 | 15 |
| 38 | — | — | — | — | — | 4 | 9 | 13 |
| 39 | — | — | — | — | — | — | 7 | 7 |
| Total | 207 | 220 | 354 | 226 | 180 | 82 | 131 | 1,400 |

## DISCUSSION

Gokhale *et al.* (1954) estimated the life span of the pearl oysters of the Gulf of Kutch as seven years, though a few individuals survive to the eighth year. According to Hornell (1922) and Cahn (1949), the Indian pearl oyster and the Japanese pearl oyster live for five and eight years respectively. We have not been able to collect oysters of the age of eight years or more, but two specimens collected from Kalumar Reef in October, 1964, had annual growth rings indicating that they were above eight years of age.

From Table 1 it is seen that the growth rate of oysters, as denoted by the increase in the length, breadth and hinge length in relation to age, is not uniform. It fluctuates and at a certain stage the growth is either retarded or stopped. The rate of variation in different age groups is also very wide. Variations in the growth rate occur within the year, as oysters grow vigorously from November to February and growth is arrested during summer. In Fig. 2, the measurements of length, breadth and hinge length are plotted against age.

Our observations show that length, breadth and hinge length are not very dependable in estimating the age of oysters, as the shell is subject to great wear and tear. In the case of thickness and hinge width, the growth rate in relation to age, is uniform and is not much affected by erosion in older shells. Figures 3 and 4 show that the thickness and hinge width are more or less proportionate to the age of the oysters and hence are more dependable.

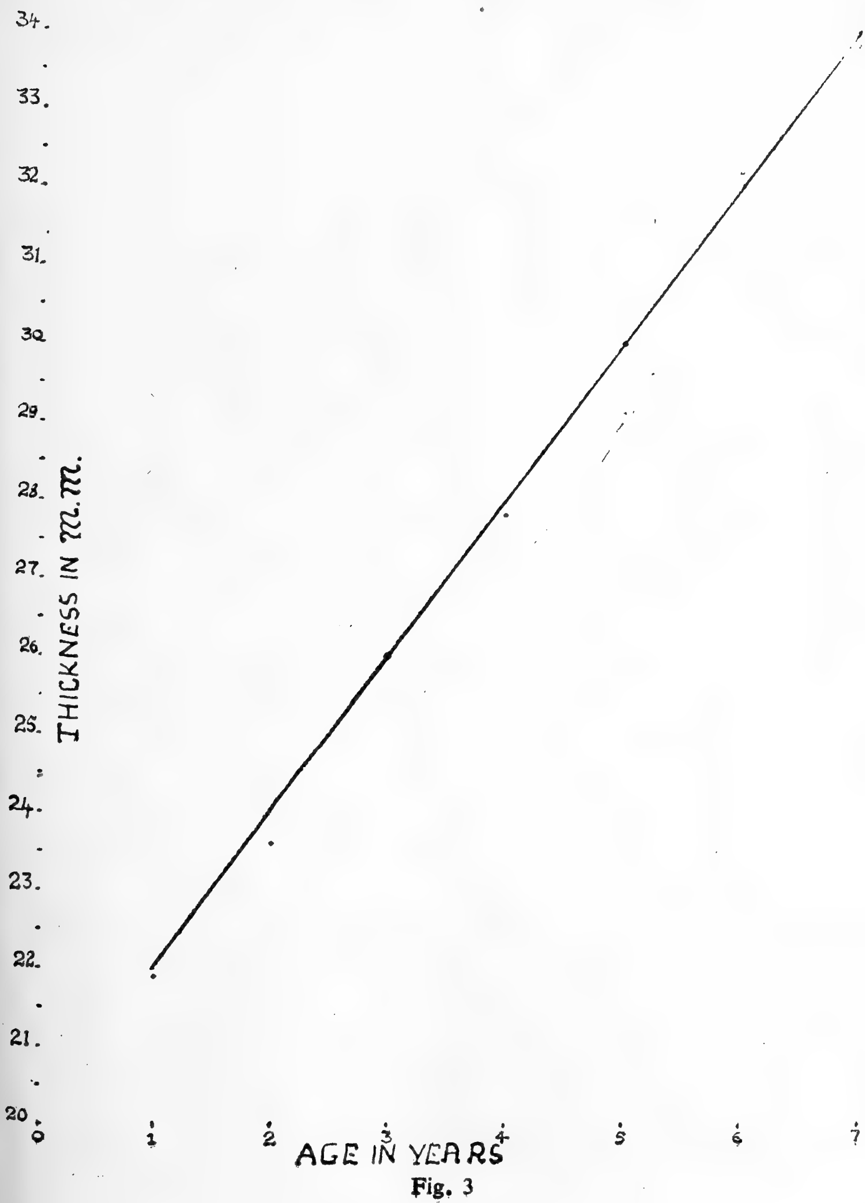



Fig. 3

Taking two points from each of the straight lines of Figures 3 and 4, an Equation of Straight Lines[1] could be arrived at, which was found to satisfy the other points of the graphs. When two points were taken

TABLE 3

CORRELATION BETWEEN AGE AND HINGE WIDTH

| Hinge width | Number of oysters of the age group | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| 1 | 7 | — | — | — | — | — | — | 7 |
| 2 | 99 | 42 | — | — | — | — | — | 141 |
| 3 | 89 | 99 | 94 | — | — | — | — | 282 |
| 4 | 12 | 65 | 125 | 70 | — | — | — | 272 |
| 5 | — | 11 | 97 | 112 | 55 | — | — | 275 |
| 6 | — | 3 | 38 | 19 | 105 | 37 | 9 | 211 |
| 7 | — | — | — | 15 | 18 | 35 | 51 | 119 |
| 8 | — | — | — | 10 | 1 | 7 | 49 | 67 |
| 9 | — | — | — | — | 1 | 2 | 18 | 21 |
| 10 | — | — | — | — | — | 1 | 4 | 5 |
| Total | 207 | 220 | 354 | 226 | 180 | 82 | 131 | 1,400 |

[2] TABLE 4

| Age | Thickness | Hinge width |
|---|---|---|
| 1 | 21·9 | 2·50 |
| 2 | 23·6 | 3·25 |
| 3 | 26·0 | 4·20 |
| 4 | 27·8 | 5·00 |
| 5 | 30·0 | 5·80 |
| 6 | 32·2 | 6·70 |
| 7 | 33·8 | 7·66 |

from Fig. 2 and they were applied to the Equation of Straight Lines, it was possible to arrive at a formula, $2a + 20 = t$, where $a$ is age in years, $t$ thickness in millimetres and 2 and 20 constants.

[1] An equation of straight lines passing through two given points $x^1$, $x^2$, and $y^1$ and $y^2$ is $\frac{x-x^2=y-y^1}{x^2-x^1=y^2-y^1}$

[2] From Tables 2 and 3, the weighted mean of thickness and hinge width at the end of every year were calculated which are shown in Table 4.

Similarly, when two points were taken from Fig. 4 and applied to the equation, the formula was $10a + 20 = 12\,w$, where $a$ is age in years, $w$ hinge width in millimetres and 10 and 20 constants.

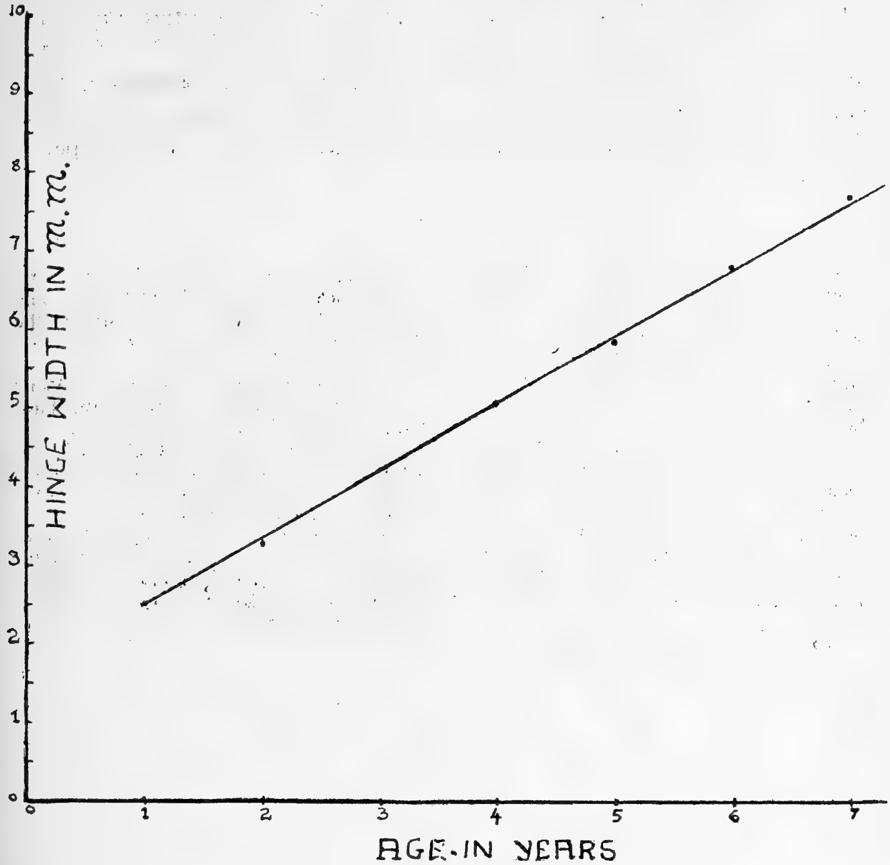



Fig. 4

## Summary

1. The growth rate of the pearl oysters, as denoted by the increase in length, breadth and hinge length, is not proportionate to age. It fluctuates and is retarded after the sixth year.

2. The increase in thickness and hinge width is more or less uniform in relation to age. When the readings were plotted on graph, they gave straight lines. The equation of straight lines could be applied to these graphs and two formulae could be arrived at, one correlating age with thickness and the other age with hinge width.

3. The thickness and hinge width of pearl oysters are more dependable for estimating age of the oysters than length, breadth and hinge length.

ACKNOWLEDGEMENTS

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# An Introduction to the Study of Indian Spiders

BY

T. V. SUBRAHMANYAM

(*With a text-figure*)

## INTRODUCTION

It is a pity that owing to ignorance man fears many harmless creatures and neglects their study. One such neglected group of animals is the spider. From the earliest times man has had an aversion for spiders. The conception that spiders are highly poisonous, noxious and ugly is purely prejudice. Scientists have proved that but for a few exceptions, spiders are generally harmless to man. Apart from the question of poison, acquaintance with spiders reveals that they form as fascinating a group as birds or butterflies. ' Among the wonders of Natural History few things are more remarkable than is the multitude of these small many-legged animals, often of beautiful structure, striking habits, and complex life-histories, yet seldom obtruding themselves upon our notice.' Their external morphological characters, their protective adaptations and coloration, their habits—all present such a range of complexity and variety that they really form engrossing subjects for study.

Consequent upon the general dislike for spiders many species of spiders in this country still remain unnamed. Regarding the ecology of Indian spiders we have but a few notes. There is therefore much scope in this field and in a tropical country like India, rich in all kinds of fauna and flora, there can never be any shortage of specimens. The systematist with the assistance of reference books and a microscope can with some trouble identify and draw up a list of all the available species ; but his chief difficulty lies in the fact that he has few named collections of species for comparison. Further in order to fully appreciate the economy of nature, the ecology of spiders should be studied more enthusiastically.

The province of this paper is primarily to recommend spider collection for those who are interested in field natural history. The aim is to describe the external characters, habits, and habitat of the common spiders met with in this country, to indicate the localities where the different genera abound, to suggest some methods of capturing them and finally

to sort them out and preserve them. This work is not intended for advanced systematists but for providing a guide to budding arachnologists.

## External morphology of spiders

A short account of the external morphology of spiders and the chief characteristics of the more common families are given below.

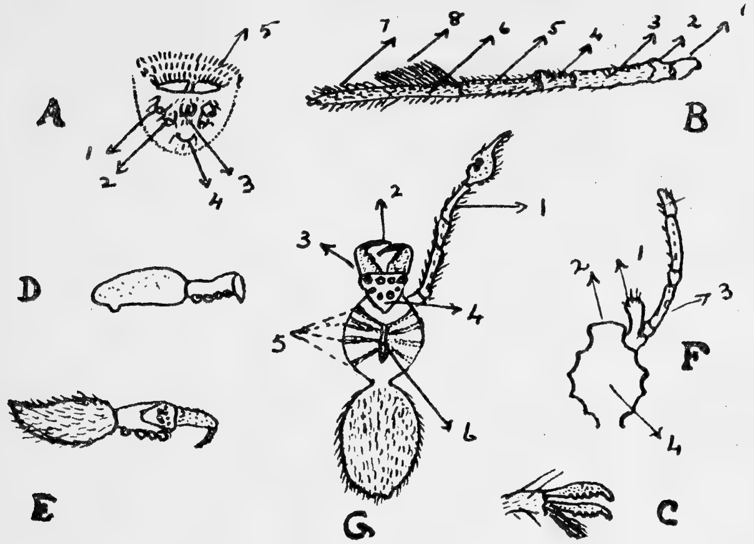
Spiders form a distinct Order Araneae under the Class Arachnida. The body of a spider can be easily distinguished by the presence of a constriction separating the anterior *cephalothorax* from the posterior *abdomen*. On the upper surface of the cephalothorax, near the middle region, a depression is noticeable termed *median fovea* and radiating from this towards the sides are certain lines called the *radial striae*. The head or the *cephalic region* or *caput* forms the anteriormost part and is generally more elevated than the thorax. The caput normally bears eight *eyes* (in some cases 6 and in a few cases 4). The eyes are arranged in two rows an anterior and a posterior, of two *laterals* and two *medians*. The row may be straight or curved with convexity backward (*procurved*) or convexity forward (*recurved*). The four median eyes together are called the *median quadrangle*. The arrangement and disposition of the eyes are of distinct taxonomical value. The ventral side of the cephalothorax is protected by a plate called the *plastron* or *sternum* usually notched at either side for the reception of the legs which are eight in number. The legs are seven-jointed, consisting of a *coxa*, *trochanter*, *femur*, *patella*, *tibia*, *metatarsus* and *tarsus* ending in a bunch of hairs the *ungual tuft* and in two or three claws. If three claws are present the ungual tuft is generally absent. In some species which have a spinning plate or *cribellum* the metatarsus, especially of the 4th pair of legs, possesses a comb-shaped set of hairs called the *calamistrum*.

The other appendages of the cephalothorax are the *chelicerae* and the *pedipalps*. The chelicerae or the mandibles consist of two joints : (1) the basal segment or *paturon* articulated immediately below the *clypeus* (the anterior edge of the head region), and (2) the distal joint, the *fang* or the *unguis* which folds against the lower side of the paturon along a groove which is toothed. The paturon contains a poison gland.

The pedipalps are six-jointed and in general shape and architecture resemble a dwarf leg minus the metatarsus. The coxa is usually furnished with a process, the *maxilla*. In the males, however, the tarsus of the pedipalp develop into a remarkable copulatory apparatus called the *palpal organ* which presents different designs in different species and is of great systematic importance.

The abdomen differs remarkably in shape in the different groups of spiders although generally it is oval, globular or cylindrical. The integument that covers the abdomen is generally smooth and flexible but

in some cases thickened and drawn into spines or tubercles. On the ventral side of the abdomen are the openings of the respiratory, alimentary and genital systems and the *spinnerets*. The *spinning mamillae* or the



A. Ventral side of the posterior end of a Dictynid Spider: 1. Anterior spinnerets; 2. Posterior spinnerets; 3. Median spinnerets; 4. Anal papilla; 5. Cribellum.
B. 4th leg of a Dictynid Spider: 1. Coxa; 2. Trochanter; 3. Femur; 4. Patella; 5. Tibia; 6. Meta-tarsus; 7. Tarsus; 8. Calamistrum.
C. Terminal portion of a spider's leg showing 2 claws and ungual tuft.
D. Profile of an Arachnomorphic spider showing horizontal articulation of the paturon with the cephalothorax.
E. Profile of a Mygalomorphic spider showing vertical articulation of the paturon with the cephalothorax.
F. Ventral side of the cephalothorax of a spider: 1. Maxilla; 2. Clypeus; 3. Palp; 4. Sternum.
G. Dorsal side of the cephalothorax of a spider: 1. Palpal organ of a male; 2. Unguis; 3. Paturon; 4. Caput showing eyes; 5. Radial striae; 6. Median fovea.

spinnerets are normally six in number, two superior, two median and two inferior. The number, however, shows reduction in some families. The spinnerets and the nature of the vulva in females are also of taxonomical value. Those spiders having a calamistrum possess in addition to the six spinnerets an extra spinning organ in the form of a double sieve plate, the cribellum, already referred to.

There is marked sexual dimorphism in spiders, the females being larger than the males. The female lays a large number of eggs all enclosed in a cocoon. The cocoons of different species differ widely in shape, size, and colour. The eggs hatch and give rise to spiderlings. There is no metamorphosis as in the case of insects.

Spiders are cosmopolitan. No part of the world is without a spider population. Spiders as a Class occur in all climes and under all cir-

cumstances. Exposed to bright sunshine, hunting on the open ground, concealed in dark crevices and holes of trees, adventurously jumping after prey along walls and fences, silently sitting confined to webs stretched along tree branches, under stones and decaying rubbish, and in the corners of shelves or inside less frequently handled office box files. For the far and wide distribution of spiders their habit of dispersal by the 'rope-trick' or 'gossamer' must be mainly responsible. Apart from this the wonderful adaptability of these creatures must be another reason. In the words of Savory 'their distribution is much more nearly that of a creature able to fly than that of a terrestrial animal, as a spider must properly be considered'.

## Classification and distinctive features of the common families

Spiders are conveniently divided into two groups the Mygalomorphae and the Arachnomorphae. In Mygalomorphic spiders the paturon is articulated with the cephalothorax in a vertical plane, the unguis closing backwards. In Arachnomorphic spiders the articulation of the paturon with the cephalothorax is in the horizontal plane and fang closes inwards.

Under each of these groups there are a number of families.

### Mygalomorphae

Most of the members are medium, and large-sized spiders of dull brown or black colour living on the ground under stones or in specialized burrows.

#### A. *Spiders with coxa of pedipalp having a large maxillary process and six spinnerets*

Family Atypidae. The anal tubercle well removed from the posterior spinnerets. Chelicerae without rastellum. Strongly built spiders with smooth integuments. Legs stout but with weak spines and three claws. They live in burrows on the ground.

#### B. *Coxa of pedipalp without maxillary process and spinnerets limited to four*

Family Ctenizidae. Mandible provided with rastellum. Posterior mamillae short or moderately long, anterior ones situated close together. Tarsus without ungual tuft but with three claws. Eyes form a compact group on an eminence. They live in silk lined burrows under stones. Some of them are trap-door spiders.

Family D i p l u r i d a e. Differs from the above in having no rastellum. Legs with three claws. Posterior spinnerets long and the anterior ones situated wide apart. Medium-sized spiders without burrows or holes but closely woven webs as residences.

Family B a r y c h e l i d a e. Medium-sized spiders with mandibular rastellum. Tarsus with ungual tuft and two claws. Spinnerets four or two in number and the extreme segments of the posterior spinnerets very short. They are all burrowing forms.

Family T h e r a p h o s i d a e. Medium or large-sized spiders differing from the previous family in the absence of the mandibular rastellum and in having the extreme segments of the posterior spinnerets long and slender. The body is hairy, the claws and tarsi having a bifid appearance. The eyes are set on a distinct tubercle. They are nocturnal in habit living under stones or holes in trees where they weave a slight web.

## Arachnomorphae

### A. *Spiders with cribellum and calamistrum*

Family F i l i s t i d a e. Ocular group compact. Palpal organ of male simple. Legs normal. Abdomen with short spinnerets : anterior pair thick and separated from others. Medium-sized spiders found under stones, bark of trees, dry leaves. Webs of close texture of an irregular tubular nature.

Family U r o c t e i d a e. Ocular group compact. Carapace rounded in front and on sides and emarginate behind. Mouth parts weak. Legs short and strong and nearly of equal length. Tarsus with three claws. Abdomen large and depressed, truncate in front and oval behind. Anterior spinnerets short, separated by a colulus. Posterior spinnerets long and jointed. Anal papilla large and hairy. Small spiders spinning slight webs under stones or in holes of walls.

Family E r e s i d a e. The four median eyes form a small quadrangle ; anterior laterals on the sides of the head ; posterior laterals far removed from the rest of the eyes and situated high up on the posterior portion of the head. Cephalic region of the carapace broad and elevated. Clypeus low. Mandibles flattish in front. Maxillae inclined obliquely inwards. Fang groove weakly toothed. Legs short, strong and thick, three clawed and weakly spined. Abdomen oval, spinnerets with cribellum. Medium-sized spiders. Webs irregular and sticky. Indian genus *Stegodyphus* of social habits.

Family Psechridae. Head moderately elevated. Clypeus high, mandibles short and strong, toothed below. Legs long and slender with ungual tufts and three clawed. The first two pairs much longer than the rest. Abdomen oval or cylindrical. Cribellum large. Fairly large spiders weaving somewhat dome-like webs and hanging within in an inverted position.

Family Uloboridae. Eyes often set on tubercle. Cephalothorax elongate. First pair of legs longer than the rest. Tarsus without ungual tufts. Abdomen rounded or oval. Anal papilla long and conically acuminate. Small or medium sized spiders weaving a regular orb-web. Common among rafters of outhouses.

Family Dictynidae. Eyes in two straight or slightly curved transverse lines. Cephalothorax oval; head broad and convex. Legs strong and three clawed without ungual tufts. Anal papilla short and semi-circular. Small spiders spinning untidy webs on leaves and twigs. General colour variable.

### B. *Spiders without cribellum and calamistrum*

Family Sicariidae. Spiders with six eyes. Cephalothorax without median fovea. Palpal organ of male simple. Legs weak, abdomen oval or rounded. Small spiders found on leaves, under stones or in outhouses.

Family Dysderidae. Spiders with six eyes. Cephalothorax rather flat. Maxillae long and scopulate. Palpal organ simple. Legs strong; sternum excavated along its border for the reception of legs. Abdomen oval or cylindrical. Indian genus *Ariadna*, common under stones and loose soil.

Family Palpimanidae. Small spiders with the first pair of legs enormously developed and thick and usually employed for feeling. Tarsi pedunculate and almost clawless.

Family Zodariidae. Small spiders with posterior spinnerets absent or much shorter than the anterior. Tarsi three clawed. Abdomen ornamented with dots or patches.

Family Hersillidae. Eyes normal. Carapace as wide as long, head region round but narrow in front. Thoracic fovea and radial striae well marked. Legs long and spiny with three claws; third pair shorter. Abdomen short and oval with posterior spinnerets long and slender—hunting spiders common on tree trunks and walls.

Family Pholcidae. Anterior median eyes small, others large forming a group on either side of the head. Cephalothorax flat and round with fovea well defined. Mandibles untoothed. Legs very thin and long, with spines. Abdomen round oval or sub-cylindrical ; spinnerets short and sub-equal. Sedentary spiders weaving untidy webs in corners and ceilings of outhouses.

Family Therididae. Strikingly resembles the following family but generally small-sized forms with rounded abdomen. Members possess a comb of spines on the tarsus of the fourth pair of legs. Webs are irregular and not perfect orbs.

Family Argiopidae. Lateral eyes on the sides of head typically close together away from the median quadrangle. Mandibles strong and toothed but variable in size and shape. Legs show great variation in different genera. Abdomen also highly variable but spinnerets normal and rosette-like behind abdomen. Sedentary spiders spinning geometrical orb-webs.

Family Thomisidae. Eyes are normal. Mandibles weak and weakly toothed. Legs strong, 2nd and 3rd pairs shorter. Abdomen prominent, oval, flat, triangular or pentagonal. Generally called ' crab-spiders '.

Family Lycosidae. Eyes of posterior row recurved and large ; anterior ones usually small, compact, and directed forwards. Mandibles strong and powerfully toothed ; pedipalp with short maxillary process. Carapace elevated and narrow in front. Legs strong and spiny, last pair longer. Abdomen long oval with spinnerets sub-equal. Powerful, hunting, ground spiders.

Family Sparassidae. Median eyes form a normal quadrangle. Carapace as wide as long ; clypeus low. Tarsal claws armed with teeth. Abdomen sub-oval.

Family Clubionidae. Median eyes arranged in a recurved crescent. Carapace flat usually wider than long. Clypeus suppressed ; maxillae project forward and not inclined on the labium. Mandibles powerful and toothed. Legs strong and spiny with scopulate tarsi ; tarsal claws unarmed. Abdomen oval with anterior spinnerets in contact.

Family Oxyopidae. Eyes form a compact sub-circular group ; anterior line recurved and posterior procurved. Carapace oval and elevated. Mandibles long and weakly toothed. Legs strong and spiny. Abdomen oval in front and tapering behind.

Family Attidae. Anterior median eyes very large ; eyes of posterior line forming a square on the sides of the head. Head region large and raised. Legs strong ; tarsi with ungual tufts and 2 claws. Abdomen oval but sometimes narrow behind. Common jumping spiders.

## Some hints to spider collectors

Although spiders are ubiquitous there are some difficulties for the collector to detect and catch them mainly because of their habits, diversity of form, colour and behaviour, calculated to deceive and surprise. There are spiders nearly as big as a small bird (*Nephila maculata*) and those as small as mites (Oonopids) ; spiders gorgeously coloured as well as insignificantly dull ; sedentary spiders with magnificent webs and also vagabonds without residence ; social spiders and cannibalistic ones ; skilful hunters (Lycosids), jumpers (Attids), excellent mimics, expert architects and specialised swimmers. The different species of spiders with their protective adaptations evade their enemies so well that unless the collector is astute and enthusiastic it is difficult to catch them.

The equipment necessary for the collection of spiders is simple. A cylindrical glass jar (2 to 2½ in. diameter and 6 in. high) containing some spirit and provided with a proper lid, a pair of forceps with flat ends, a muslin kerchief and a small net like the one usually employed by butterfly collectors, are enough for spider collection.

Sedentary spiders resting on walls, leaf blades, tree-trunks or in the webs can be caught in the jar by holding it open beneath them and by tapping the spiders into it with the lid. Running and vagabond species like lycosids and attids can be caught by throwing a kerchief over them and carefully holding them with the hand in the folds, transfer them into the jar. Small spiders residing among grass and herbage can be caught in the net by sweeping it sideways. Shake a tree branch vigorously, and spiders living there will be thrown off and will attempt to climb up by their threads when it is easy to tap them into the jar. In handling spiders the use of forceps must as far as possible be avoided as the brittle limbs give way easily.

## Grouping and Identification

Spiders being collected in spirit, are already killed and the collector has only to sort them out. With the assistance of literature on the subject and with an ordinary lens, it would not be very difficult to group the collection into the principal families. Put the specimens into separate tubes (flat-bottomed) with labels containing information regarding date and place of collection and the collector's name. Close the mouths of the tubes with tissue paper. Immerse all the tubes in a big Kilner-jar con-

taining dilute spirit or a mixture of glycerine and formalin. Spirit is generally preferred as formalin hardens the specimens. Before closing the Kilner-jar, see that all spider tubes are well under the spirit level.

For identification of the specimens and for placing them under proper genera and species, the student will have to consult some standard systematic reference book such as the FAUNA volume on Arachnida by Pocock. It should, however, be borne in mind that since this book was published certain families have been revised and supplemented by other authors. Moreover, many families are altogether omitted in this work and the species dealt with under the different families are limited, being possibly based on the actual specimens examined by Pocock during his study. Therefore for a comprehensive study this book is inadequate. There is still much work to be done on Indian attids, theridiids and several other families. Dr. F. H. Gravely, late Superintendent of the Government Museum, Madras, contributed several papers on Indian lycosids, ctenids, sparassids, selenopids and clubionids. These papers appeared in the *Records of the Indian Museum*, Calcutta, during the years 1921 and 1924. Other contributors on Indian spiders are Rae Sheriffs, Dayal, and more recently, Tikader. Literature on extralimital species should also be consulted for grouping Indian species. Cecil Warburton's chapter on spiders in the Cambridge Natural History Series, Savory's BIOLOGY OF SPIDERS, Thorell's SPIDERS OF BURMA, Ellis's SPIDERLAND, Comstock's COMITY OF SPIDERS etc. are books which should be read by every spider collector.

In order to bring the list of spiders occurring in this vast country up-to-date, more workers are required and it is believed that the spider enthusiasts will receive necessary assistance and encouragement from our Universities, Natural History Museums and the Zoological Survey of India.

(*to be continued*)

# Reviews

1. POPULATION STUDIES OF BIRDS. By David Lack. pp. v+341 (24×16 cm.), Oxford, 1966. Clarendon Press. Price 63*s*.

The author's earlier work THE NATURAL REGULATION OF ANIMAL NUMBERS appeared in 1954. In the same year, Andrewartha and Birch put forward their views in their book THE DISTRIBUTION AND ABUNDANCE OF ANIMALS. Since then numerous critiques of both views have appeared. More recently, in 1962, Wynne-Edwards advocated evolution through group selection, in his book ANIMAL DISPERSION IN RELATION TO SOCIAL BEHAVIOUR. Moreover, in the last two decades definite, though slow, progress has been made in the field, and so, the present book has come none too soon.

The book is based mainly on the long-range detailed studies of 13 species of birds, made by different teams, or individual workers, in England (9 studies), tropics (2 studies), Germany (1 study) and New Zealand (1 study); 11 minor studies relevant to the major ones are also used. Each species is discussed separately, in most cases in a chapter, or a part of it. However, one does not miss the continuity from one chapter to the next, as the book is carefully planned and the chapters are interwoven with the numerous themes reoccurring in many chapters and the author's scholarly exposition of Nicholson's theory of population dynamics. The following account, largely in the author's own words, will give an idea of the numerous problems discussed in the book.

Discussing the role of territory, the author is not blinded by an ever-growing list of functions attributed to the territory. 'The territorial behaviour of most species of birds is generally considered to assist in pair-formation, while in many of them a wide spacing of the nests presumably assists their concealment from nest-predators; defence of a nesting site similarly, ensures safe breeding for hole-nesting species. Hence there seems no need to postulate any additional function of territory. Nevertheless, in various species any owners of territories that die are rapidly replaced, so territorial behaviour plays some role in breeding dispersion. But both the nature and the functions of this role are still obscure, and the seemingly obvious view that territorial behaviour limits numbers in relation to the food supply requires more critical study than it has yet received' (p. 279).

The author's earlier view that 'the breeding seasons of single brooded species have normally been evolved so that they lay their eggs at such a time that their young hatch in the most favourable period for raising them, usually when their food is most abundant' (p. 272), has been modified in this book. Several examples cited indicate that the food available to the laying female may be a chief proximate factor determining the time of egg laying. 'Murton found that the gonads of the Wood Pigeon are in breeding condition for longer each year than the period in which laying actually takes place, and he concluded that the main proximate factor inducing laying was the food supply. . . . . A long potential breeding season, with food as the proximate factor inducing laying, is presumably what has enabled the Wood Pigeon to adapt its breeding season so successfully to man's grain harvest' (p. 179). For the Bullfinches in England, Newton showed that the main diet in the spring prior to breeding is buds, 'but they turn to fresh seeds when these become available in late April. Probably this is what determined the start of breeding in early May, because buds contain comparatively little nutriment, and seeds might well be needed before the hens can form eggs. Also when Newton provided eight hens in outdoor aviaries with seeds, six of them laid eggs in mid-April, a fortnight before he found any eggs in the nearby woods' (p. 188). In the Pied and Collared Flycatchers, 'there is a correlation similar to that found in the Great Tit between the preceding spring temperatures and the average date of laying each year, but these flycatchers are migrants which arrive on their breeding grounds only in late April, so do not themselves experience most of the temperatures in question. Hence they presumably respond either to the appearance of fresh green vegetation or to their insect foods, both of which appear earlier in a mild than a cold spring' (p. 20).

The data presented in the book largely substantiate the author's view 'developed especially for birds, that the reproductive rate (in particular, the number of eggs in the clutch) has been evolved through natural selection to correspond with that number which, on average, gives rise to the greatest number of surviving offspring' (p. 3).

The clutch-size, however, is subjected to phenotypic modifications. Such modifications during the course of a breeding season may be 'adapted to the subsequent food requirements of the young. In the Great and Blue Tits, Pied and Collared Flycatchers, Swift and Kittiwake, clutches tend to be largest at the start of the season and thereafter to decline, and there is evidence that these species find it harder to raise young later than earlier in the season. In the Blackbird, Song Thrush and Robin, on the other hand, clutches laid in the middle of the season are larger than those either earlier or later;

correspondingly, the food available for these species in woods is more plentiful in mid-season, and this is also near to the time when the days are longest' (p. 274). The clutch size in the Great, Blue and Coal Tits is inversely correlated with the population density. This variation in the Great Tit (and also in other tits) is 'presumably adapted to the food situation for the nestling tits because, other things being equal, it is harder for a parent to find food for its young when there are more than few Great Tits searching for it' (p. 28). 'Similarly in the Great Tit, Blackbird, Yellow-eyed Penguin and Kittiwake, older females lay rather larger clutches than those breeding for the first time and are also rather more efficient in raising young' (p. 274).

The clutch size is affected by the feeding condition at the time of egg laying. This is so in the Cuckoo, though it is 'a special case because it is a brood parasite' (p. 6). There are circumstantial evidences that in gallinaceous birds, 'clutch-size is affected by the amount of food available to the female during or just before laying . . . These findings do not mean that the food available to the hen birds at the time of laying is the sole factor affecting the clutch-size of gallinaceous birds. Hereditary factors must also be involved, at least in determining the size of the eggs, and hence the amount of food needed for each, and probably also in determining the limits between which the clutch-size of each species can be modified by the food supply at the time of laying' (p. 6 and 7). 'Finally, in the Tawny Owl, Short-eared Owl, and Bullfinch, larger clutches are laid when their main food, woodland mice, field voles and certain seeds respectively, is more abundant than in other years' (p. 274).

Certain modifications in clutch-size are non-adaptive. The Great and Blue Tits and the Pied and Collared Flycatchers tend to lay smaller average clutches when the breeding season starts later. This is apparently not correlated to the amount of food supply available for the young.

There are some exceptions to the author's view on the clutch-size. In the Glaucous-winged Gull, on Mandarte Island, British Columbia, 'as in nearly all other species of *Larus*, the normal clutch is three, but Vermeer showed that, at least in one year, the parents were able to find enough food to raise four, five or even six young, and the proportion of young lost in these large broods was similar to that in broods of three . . . Possibly, however, the present situation on Mandarte Island is unusually favourable for the feeding of the Glaucous-winged Gull, as it is increasing rapidly, which is attributed to the food supplies unintentionally provided by mankind on city refuse dumps' (p. 247). Similarly, in the Gannet, 'more young survived

per brood from artificially made up broods of twice the normal size than from broods of normal size. . .' (p. 251).

Following Skutch, a number of workers have maintained that the clutch-size for several tropical species is far smaller than the number of nestlings the parents can feed. 'Snow argued that, since the Black and White Manakin can obtain all its food in under 10 per cent of the day, the female should in the course of the whole day be able to find much more food than is needed for herself and two nestlings. He therefore agreed with Skutch that the reason that such species have evolved a clutch of two cannot be because two is the greatest number of young which they can feed. Instead Skutch suggested and Snow agreed, that if there were more than two young, the parent would have to bring food more frequently and would therefore be in greater danger of revealing the nest to predators' (p. 170). The author, on the other hand, thinks it likely that 'predation is not the main factor which has led to the evolution of a clutch of two in manakins, and that further study should be made to determine whether two might be the largest number of young for which the parent can find enough food. Admittedly fruits are abundant during the breeding season, but they are not a satisfactory diet from which to form proteins . . . Snow found many more remains of fruit than insects below nests with young, but fruit is more likely to leave remains than insects, so insects perhaps comprise more of the nestlings' diet than he thought. Hence the critical factor limiting brood-size might be the time taken by the female to find insects, but this needs testing . . .' (p. 171).

The author's interpretation of the adaptive significance of asynchronous hatching in raptorial and other birds, that 'all the food goes to the first-hatched and largest nestlings until they are satisfied' and that 'if the food is plentiful the youngest then receives enough', but 'if food is sparse it is not wasted on young that would die anyway' (p. 223), is extended to the asynchronous hatching in the White Stork. 'The position is more complex in the White Stork than in other species with asynchronous hatching because nestling sometimes dies, not of starvation, but through being thrown out of the nest, or even killed and eaten, by one of its parents which Schüz (1957) named "chronism" after the titan Chronos who ate all save one of his offspring' (p. 223). It is possible that 'parent Storks kill primarily such nestlings as do not respond adequately to them because they were already weak from starvation, in which case the parents merely accelerate deaths that would occur anyway, and thus ensure that food will not be wasted on a dying chick' (p. 224).

Most of the species considered in the book breed at the age of one or two years. But, 'in the White Stork and in those sea birds discussed here, breeding starts at an age varying between two and seven years or more, depending on the species. There is neither evidence for 'the view of Wynne-Edwards (1955, 1962) that such deferred maturity has been evolved through group-selection in long-lived species to reduce the number of young and so prevent over-population,' nor foı the author's alternative view that, 'in such species, breeding is difficult and individuals which try to breed when younger than the normal age leave, on the average, fewer not more surviving young than those which start later' (p. 275).

The data on adult mortality seem to fit with the author's view that 'the higher the reproductive rate the higher the annual mortality, . . . a simple consequence of population balance through density-dependent regulation of the mortality' (p. 275). Food shortage is the main density-dependent mortality factor. In some species there is positive evidence for the limitation of numbers by food outside the breeding season. 'The correlation between the number of Wood Pigeons alive in early March and the availability of clover indicates that the number of birds remaining alive on the area keeps close to that which the declining quantity of food can support. This happens because there is direct competition of food in the feeding flocks, and one individual not infrequently displaces another from an item which it has found, with the result that some of the displaced individuals, presumably those in the social hierarchy fail to get enough food and die' (p. 187). 'A peck-order is of survival value both to those higher and to those lower in the order, for those higher because they obtain food with very little fighting, and for those lower because it saves them wasting time on fights which they would anyway lose, and their energies can be conserved for searching elsewhere' (p. 276). The Quelea, one of the two tropical species considered in the book, 'may be limited in numbers by its food supply. It need not, of course, be so limited throughout the year, and during much of the year the small seeds of wild grasses which it prefers are abundant. As already mentioned, it is primarily when these small seeds become sparse in the later part of the dry season that the Queleas turn to larger seeds, including human crops. But the time when food becomes really scarce for them, at least in Nigeria, is in early rains, at the end of June and through July, since in this period all the wild seeds that are left on the ground start germinating' (p. 157).

The appendix at the end of the book gives a chapter-wise summary of the NATURAL REGULATION OF ANIMAL NUMBERS which is now out of print, and 22 pages of discussion on the alternative views, mainly of

Andrewartha and Birch and Wynne-Edwards, on population dynamics. The bibliography contains 467 titles referred to in the book. Illustrations include 31 graphs and charts and 27 excellent line drawings of the species discussed in the book.

An elegant exposition of a large and important literature on bird population makes this a standard reference book for ecologists and ornithologists. The author's focus on the slow rate of progress in the field, emphasizes a need to attract scientists of diverse disciplines towards population studies. Handling of some of the problems, such as, the factors involved in starting and terminating the egg laying and modifying the clutch-size, adaptive significance of clutch-size in tropical birds and the relative efficiency of the young and old parents in raising their brood, which are not conclusively established, should yield quick results in the hands of experimental zoologists. To these workers, the meticulously collected information on a few species of birds and the objective analysis of different points of view should be of great use. Finally, ornithologists concerned about the paucity of imaginative reading material on Field Ornithology for graduate training, will find what they want in this book.

R. M. NAIK

2. THE METABOLISM OF INSECTS. By Darcy Gilmour. pp. ix+195 (21×14 cm.). Edinburgh/London, 1965. Oliver & Boyd. University Reviews in Biology. Paper Back. Price 15*s*. net.

THE METABOLISM OF INSECTS by Darcy Gilmour is a welcome addition to the literature in biochemistry. It is valuable in that different aspects of insect metabolism are treated in a very precise manner, and the book should be of great value to students at the post-graduate level.

The book is divided into nine main chapters dealing with energy metabolism (two chapters), carbohydrate metabolism, lipid metabolism, metabolism of insecticides, metabolism of amino acids, metabolism of some N-cyclic compounds, protein metabolism, and the control of metabolism. Each chapter is further divided under several subheadings.

In the chapters on energy metabolism the author discusses, among other topics, sources of energy, catabolism of carbohydrate, oxidation of fat, oxidation of amino acids, terminal oxidation, and anærobic phase of energy metabolism. The chapter on carbohydrates deals with different kinds of carbohydrates utilised by insects in their diet and storage of food and in the formation of cuticle. Various enzymes

involved in the metabolism of monosaccharides, oligosaccharides, and polysaccharides (chitin etc.) are discussed. Storage polysaccharides and glycoproteins or mucins, which perform a variety of structural and lubricating functions, are dealt with in detail.

The section dealing with fats describes the storage of fats, metabolism of fatty acids and glycerides, synthesis and hydrolysis of glycerides, transport of fat, and conversion of fat into carbohydrates. Hydrocarbon derivates of physiological importance with special reference to the behaviour of insects, designated as pheromones, and the role of other lipid derivatives secreted by insects for defence purposes are discussed under the subheading 'Pheromones'. The chapter on insecticides deals with important insecticides, their action, and the mechanism of detoxication developed by insects to resist their effect.

The short concluding chapter is devoted to the reviews of control mechanism and hormonal control of the metabolism of the whole insect. Regulation within the cell, between cells, and between individuals of the same species is also discussed.

References are few compared to the volume of the data reported. Additional references in appropriate places would be of great help to students for the detailed study of particular topics. References at the end of each chapter rather than collectively at the end of the book would have been more convenient.

ALMAS RIZVI

3. ECOLOGICAL METHODS: WITH PARTICULAR REFERENCE TO THE STUDY OF INSECT POPULATIONS. By T. R. E. Southwood. pp. xviii+391 (23×15 cm.). London, 1966. Methuen & Co. Ltd. Price 75*s*. net in U.K. only.

Research workers tend to work in compartments. Medical entomologists seldom know what agricultural entomologists are doing, and vice versa. To a non-ecologist a book like this is especially useful as a guide to developments in other fields, and as a source of ideas which can be adapted to his own field.

By and large ecological methods have not been applied to the study of insects of medical importance. A few of the techniques used have been adapted. For example, the Rothamsted suction trap for sampling a unit volume of air has been adapted by Lumsden for mosquitoes on a living host. No work has, however, been done on the efficiency of the modified trap under different conditions, nor has it been used very much.

There is an interesting chapter on marking and capture-recapture techniques, which ought to be read by everyone concerned with

problems of absolute population densities. The simple 'Lincoln index' was first used on ringed and recaptured birds, and was applied to tsetse fly populations by Jackson in 1933. Since then it has become a very sophisticated tool.

There is necessarily a great deal of mathematics in the book. The basic principles are explained very clearly, however, and the sampling methods described are of interest to all kinds of entomologists.

R. R.

4. COMMON INSECTS OF INDIA. By N. P. Kalyanam. pp. x+136 (21·5×14 cm.). Bombay. Asia Publishing House. Price Rs. 12.

Books on insects in India are few whether they deal with economic or systematic entomology, though insects play such an important part in the daily life of man. Books and publications on the subject, therefore, are very welcome and should be encouraged. This book is an introductory effort about information on insects. It gives, in brief, a fairly good idea regarding the division of this class into different orders and families and a few important insects of economic importance in each. The large number of illustrations help the reader in identification. However, a few suggestions for incorporation in the next edition, may not be out of place.

The size is important and a scale by the side of each illustration would be more useful than mentioning it in the text.

While describing a family, the name of one important insect of that family is mentioned above the family name, giving the impression that only that insect is dealt with, whereas actually the whole family is described.

Descriptions in some cases are too brief. By adding a few words in some of them at least, much more information could be given, e.g. where there is sexual dimorphism as in the case of most species of Lampyridae (male winged, female wingless). Similarly brilliance in the coloration of Aspidomorpha (p. 114) deserve mentioning: *E. fabia* has a green band in the middle of the forewing etc.

N.T.N.

5. AVIAN MYOLOGY. By J. C. George and A. J. Berger. pp. xii+500 (15×24 cm.). 247 illustrations. London and New York, 1966. Academic Press. Price $18·00.

The joint endeavour of J. C. George, a pioneer in comparative histochemistry, and A. J. Berger, an outstanding worker on the morphology of avian muscles, has resulted in the production of a much-needed treatise on avian myology. The book not only covers almost all the modern topics in the study of avian musculature, but brings out also the previous shortcomings in this branch of study and the complicated problem of nomenclature of bird muscles.

Two aspects are broadly treated in the book. The first and the major one, is a review of the work done on the histochemistry of avian muscle fibres, specially those of the breast muscles; the second deals with the anatomy of the various muscles of birds. The book concludes with suggestions on the trends of evolution of the avian pectoral muscles deduced from histochemistry and biochemistry.

Though apparently a synopsis of the authors' researches on avian muscles, the book is, nevertheless, an excellent guide for advanced students of avian myology, especially for those interested in its modern aspects. It covers such topics as morphology, histology, histochemistry, histophysiology, biochemistry and evolution of flight muscles. In fulfilling a task of this magnitude, certain lapses are bound to creep in, many of which are due to lack of information, for which the authors are not to blame. The book, however, could have been more useful to the beginners if the authors had given a complete and thorough picture of the avian muscles. A major shortcoming of the treatise is perhaps the lack of detailed skeletal account both in the text and in illustrations: tubercles, ridges, etc., essential for the study of muscle-insertions. The description of the two major pectoral muscles similarly suffers from lack of detailed anatomical account. Equally disappointing is the absence of references to other minor pectoral muscles and the tendon-complex inserting on the humerus. Among the other short-falls, some errors in the zoological names of birds, omission of a few text-references in the bibliography, and lack of a key to the biochemical abbreviations often used, need mention. Illustration of the wing- and leg- muscles, and of histology are good, but those of the jaw-muscles could have been better. Functional morphology, especially of the jaw-muscles—and a much-studied topic of avian myology in recent years—has been entirely avoided in the book. Not even the excellent bibliographies at chapter ends satisfy a reader interested in this topic.

However, AVIAN MYOLOGY is a milestone in an extremely difficult and little-known field of avian biology. The reviewer is certain that for many years to come the book would remain a standard reference to students of ornithology, especially those of avian myology.

A. DE

# Miscellaneous Notes

## 1. *SPHAERIAS BLANFORDI* (THOMAS, 1891) FROM HIMALAYAN REGION OF UTTAR PRADESH : AN ADDITION TO THE CHIROPTERAN FAUNA OF INDIA

Blanford's Fruit Bat, *Sphaerias blanfordi* (Thomas, 1891) was first described under the genus *Cynopterus* F. Cuvier, 1824, on the basis of specimens collected in Karen Hills, Burma. The genus *Sphaerias* was created by Miller (1906) to include this single species which has some remarkable morphological differences from other members of the genus *Cynopterus*. Tate (1947) studied additional material of this species from Mt. Angka in northern Siam and included Thailand in its distribution. The same distributional records for this species have been given by Ellerman & Morrison-Scott (1951) and the species has not so far been recorded in India.

In all 15 males and 39 females of this species were collected by the author during recent tours in the Himalayan region in Uttar Pradesh, in connection with a survey of haematophagous arthropods. The bats were trapped in Japanese mist nets which were set up near fruit orchards, edges of forests, and wheat fields. Skins and skulls of three males and six females were preserved for study. In addition, skulls of two males and four females were also prepared. The species was identified after a study of these preserved skins and skulls. Other specimens recorded here were identified by comparing them with the preserved material.

Detailed collection data are as follows : 2 ♀♀ from Dharchula in Kali Valley, alt. 1070 m., Pithoragarh District, on 17 and 18 March 1967, skin of one and skulls of both the bats preserved ; 3 ♀♀ from Kotera near Dharchula, alt. 1130 m., on 19 and 20 March 1967, skulls of all the three preserved ; 1 ♂ and 2 ♀♀ from Kataithbara near Bageshwar in Sarju Valley, alt. 920 m., Almora District, on 23 March 1967 ; 4 ♂♂ and 11 ♀♀ from Kuiti near Tejam, alt. 1220 m., Pithoragarh District, on 3 and 4 April 1967, skin and skull of one female preserved ; 2 ♂♂ at Gwaldam on Nandakeshri road, alt. 1920 m., Chamoli District on 9 April 1967, skin of one and skulls of both preserved ; 1 ♀ from Deosari range forest near Gwaldam, alt. 1980 m., on 12 April 1967 ; 4 ♀♀ from Guliyo at Gopeshwar, alt. 1070 m., Chamoli District, on 27 May 1967, skin and skull of one female preserved ; 2 ♂♂ and 1 ♀ from Tejam in eastern Ramganga Valley, alt. 1070 m., Pithoragarh District, on 13 September 1967, skin and skull of the female preserved ; 1 ♀ from Lilam in Johar Valley, alt. 1830 m., Pithoragarh District, on 17 September 1967 ;

MEASUREMENTS IN MILLIMETRES OF PRESERVED SKINS AND SKULLS *Sphaerias blanfordi* (Thomas, 1891)

| | Dharchula ♀ | Kuiti ♀ | Gwaldam ♂ | Guliyo ♀ | Tejam ♀ | Dummer ♀ | Girgaon ♀ | Girgaon ♂ | Dhakuri ♂ |
|---|---|---|---|---|---|---|---|---|---|
| Head and Body .. | 91·5 | 92 | 95 | 82 | 92 | 88 | 88 | 92 | 84 |
| Forearm .. | 51·5 | 51·5 | 48·5 | 51 | 51 | 52·5 | 53 | 53·5 | 51 |
| II Finger—Metacarpal .. | 22 | 24 | 22 | 23·5 | 23 | 24·5 | 23 | 24 | 24 |
| III ,, — ,, .. | 34·5 | 37 | 33 | 37 | 36·5 | 37 | 35 | 36 | 35 |
| I Phalange .. | 25 | 26 | 22·5 | 28 | 25·5 | 26·5 | 25 | 26 | 25 |
| II ,, .. | 36 | 35 | 31·5 | 36·5 | 34 | 34·5 | 34 | 36 | 32·5 |
| IV ,, — Metacarpal .. | 35 | 35 | 31·5 | 36 | 35·5 | 36 | 34 | 35 | 33·5 |
| I Phalange .. | 18·5 | 18·5 | 17·5 | 21·5 | 19·5 | 20 | 19 | 19 | 18 |
| II ,, .. | 22 | 22·5 | 21·5 | 23·5 | 23·5 | 22 | 22 | 23 | 21·5 |
| V ,, — Metacarpal .. | 32·5 | 33 | 31 | 35 | 33 | 35 | 32·5 | 33·5 | 33 |
| I Phalange .. | 16 | 16 | 14·5 | 18 | 17 | 15·5 | 16·5 | 16 | 14·5 |
| II ,, .. | 19 | 20 | 18·5 | 24 | 19·5 | 19 | 19 | 19·5 | 18·5 |
| Tibia .. | 18·5 | 18·5 | 17 | 17·5 | 16 | 18 | 17·5 | 18 | 17·5 |
| Skull length .. | 26·5 | 27·5 | 26·5 | 28 | 27·5 | 27·5 | 28 | 27·5 | 27 |
| Zygomatic breadth .. | 15·5 | 17 | 16·5 | — | 16 | 17 | 17·5 | 16·5 | 17 |
| Mandible .. | 19 | 21 | 19 | — | 20 | 20 | 20 | 20 | 19·5 |
| Upper Dental row .. | 9·5 | 10 | 9·5 | — | 10 | 10 | 10·5 | 10·5 | 10 |
| Lower Dental row .. | 10 | 10·5 | 10·5 | 11 | 11 | 10·5 | 11 | 10·5 | 10 |

2 ♀♀ from Dummer in Johar Valley, alt. 1680 m., Pithoragarh District, on 25 September 1967, skin and skull of one specimen preserved ; 4 ♂♂ and 4 ♀♀ (three adults and one juvenile) from Girgaon, alt. 1980 m., Pithoragarh District, on 27 September 1967, skins and skulls of one male and one female preserved ; 2 ♀♀ (juvenile) from Kapkot in Sarju Valley, alt. 1130 m., Almora District, on 30 September 1967 ; 1 ♂ from Dhakuri in Pindar Valley, alt. 2710 m., Almora District, on 2nd October 1967, skin and skull preserved ; 3 ♀♀ (one adult and two juvenile) from Khati in Pindar Valley, alt. 2290 m., Almora District, on 3 October 1967 ; and 1 ♂ and 3 ♀♀ from Loharkhet in Sarju Valley, alt. 1920 m., Almora District, on 10 October 1967.

It is interesting to note that the bat *Sphaerias blanfordi* was met with only in the interior valleys during the survey at elevations between 800 and 2710 metres while the other species of fruit bats namely *Cynopterus sphinx*, *Eonycteris spelaea* and *Rousettus leschenaulti* were collected from outer valleys and lower elevations. However, their populations were found mixed with *Sphaerias blanfordi* at elevations between 800 and 1000 metres between the Himalayan high ranges and the foot hills.

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## 2. SOME OBSERVATIONS ON THE GOLDEN LANGUR *PRESBYTIS GEEI* (MS. KHAJURIA) GEE

### INTRODUCTION

The author and his wife stayed in the Manas Wild Life Sanctuary from 25 March to 13 April 1967 and during this time they spent six days observing a troupe of Golden Langurs *Presbytis geei* in the forest on the Bhutan side of the Manas River.

### DESCRIPTION OF HABITAT

The jungle in this area falls within the type known as tropical moist deciduous (Champion 1938). The trees are high, up to 150 feet, and the canopy is almost closed, dominant species being deciduous. Climbers

are numerous and the shrub layer beneath the trees is dense in patches, elsewhere the forest floor is covered with fallen leaves which at this time of the year are dry and brittle. A feature of this type of forest is that the trees undergo a leafless period during the dry season at the end of which new leaves or flowers are produced in a sudden rush. Some trees burst into flower while still leafless especially *Erythrina*, *Salmalia* and *Cassia fistula*. The leafless period was just ending and many trees were in flower when the following observations were made.

## Habits

*Size and composition of population*

The study area consisted of a comparatively small part of the forest surrounding the Manas Bhutan camp and probably did not exceed one square mile. It was difficult to count the exact number of langurs living in the area due to the thickness of the overhead canopy in some places and the speed with which the monkeys made off when approached. It is known that there were not less than twenty nor more than thirty-five individuals present.

Sometimes virtually all the langurs in the area would congregate in certain trees where food was plentiful. However, such large groups were wary and when approached the langurs would dash off through the trees in several directions. There appeared to be two main groups of eleven and seven animals and these formed the basis of our observations.

Both groups were presided over by a dominant adult male and in the larger group some quarrelling was observed between the largest male and another almost as big. On one occasion during a fight the larger drove his opponent almost to ground level within a few feet of the observers.

Two adult females in the larger group each had a baby clinging to her body between her front legs, while one female in the smaller group was carrying a very young baby. The rest of the animals in both groups consisted of females without young, or sub-adults.

*Breeding season*

The largest of the three babies seen was still being carried by its mother though it would sometimes leave her and climb about on its own, even jumping small distances from bough to bough. Once it ran to the end of a bough and, faced with a long leap to the next tree, went through all the movements the langurs make when working up for a big jump. Grasping a branch on each side with their hands they rock backwards and forwards, finally launching themselves by pulling forwards with their arms while springing with their hind legs. Adults can cover enormous distances, in the region of 20 feet from tree to tree, although dropping

almost as far in the process. On this occasion the young langur decided the gap was too wide and ran back to its mother who jumped with it clinging beneath her body.

The youngest baby was still very small, it never left its mother and was quite easy to overlook when the female was climbing about in the trees. She spent much time grooming it, sitting in an upright position on a bough with the baby in her lap while she carefully combed its fur with her long fingers. At other times she would hold it to her breast to suckle. The age of this baby was estimated to be between one and two months and the breeding season of the Golden Langur would therefore seem to fall between December and February.

*Feeding habits*

The langurs were active from shortly after dawn throughout the hours of daylight but they invariably spent from $1\frac{1}{2}$ to 2 hours resting during the heat of the day. Towards noon the group would congregate high up in a tall liana-draped tree, there they would sit huddled in the shade of the creeper. During their siesta they remained very still and were often well hidden ; at this time they would allow the observers to walk beneath the tree and no amount of hand clapping, shouting, or hurling of small stones would make them move.

When they awoke the langurs dispersed amongst the trees and recommenced feeding until dusk when they settled down for the night, usually high up in a liana covered tree. According to the forest department staff they sometimes moved down to the river to drink during the afternoon, lapping the water or licking the rocks which in places are rich in minerals. This behaviour has been described by Gee (1964) but was not seen during the present study and may depend upon what other source of water is available to the langurs. At this season of the year they feed largely upon the succulent cherry-like buds and flowers of the 'Balu ' tree, *Dillenia pentagyna.*

The langur's normal posture when feeding is to sit on a bough holding it firmly with one or both hind feet, its long tail hanging down and both hands free to pluck the leaves or flowers which are then transferred to its mouth, or a spray of foliage may be pulled down and eaten straight off the twig. When adopting the first method the langur often plucks a single petal most daintily. The animal is always careful to retain its grasp on a bough with its feet or hands.

During this study (25-31 March) the Golden Langur was seen to feed on the following :—

| | |
|---|---|
| *Dillenia pentagyna* | .. buds and flowers |
| *Careya arborea* | .. ,, ,, ,, |
| *Bombax ceiba* | .. ,, ,, ,, |

*Bauhinia vahlii* .. leaves
An unidentified climber, possibly of the Leguminosae .. leaves

*Mode of progression*

When moving through the tree tops the langurs make use of horizontal boughs whenever possible, running along them on all fours or occasionally, when circumstances allow, running in an upright position but grabbing the vegetation on either side in their hands. In each case the long tail is used as an aid to balance. Their method of leaping from tree to tree has been described above. During its flying descent the animal adopts what is virtually a sitting position in the air with its feet and arms thrust out in front ready to seize the next bough and its long tail streaming out behind. At times such leaps are prodigious and quite often the animal only manages to grab the tip of a bough or hanging strand of creeper in one hand to dangle in space before getting a grip with its other hand. At such times it will travel short distances by brachiation but this is not its normal method of progression.

Members of a group almost invariably followed one another along an exact course when on the move, often queuing up to leap across a gap. If followed for a considerable time a group would become very strung out, the adult males and females carrying babies being left far behind by the nimbler sub-adults. Even under these conditions each individual followed the same route.

If suddenly alarmed a group dispersed in every direction but once the danger was over they reassembled. Such behaviour evidently has survival value in the event of an attack by a predator.

Once they became used to the presence of the observers the langurs would permit us to move about quietly beneath the trees without taking fright although they always showed signs of nervousness if we stood directly beneath them, then they would defecate and urinate. Since alarm would have caused them to flee it would seem that this behaviour was merely the result of nervousness though the accuracy at times might suggest that it was a conscious act on their part.

*Voice*

The most commonly heard utterance of the Golden Langur was a low-pitched, fast repeated *ur-ur-ur-ur-* usually made when quarrelling or mildly disputing food or right of way. This noise is of low intensity and not unlike the ' whickering ' of the European Badger *Meles meles*. If suddenly alarmed the langurs uttered a harsh bark of anger, this was always a double note *agh-agh* repeated at intervals.

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The author is especially grateful to Mr. E. P. Gee for all his help and advice which made the expedition to the Bhutan Manas Sanctuary possible. He also wishes to acknowledge with gratitude the assistance given by the staff of both the Bhutan and the Assam Forest Departments.

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## 3. BREEDING HABITS OF THE FIELD RAT *MILLARDIA MELTADA* (GRAY)

### INTRODUCTION

Of the 91 species of rats and mice found in India, at least 25 occur in the Punjab (Deoras 1964). Among the field rats found around Ludhiana, *Millardia meltada* (Gray) is very common and comprised 50 per cent of the rats collected during September-November. It is abundant, and along with other species of rats, causes serious damage to important field crops like wheat, gram, sugarcane, groundnut etc. Previously, efforts to breed *Tatera indica*, another important species, in captivity for studies on its biology did not meet with success due to its cannibalistic habits (Singh 1961). Cannibalism was a problem in *M. meltada* also, but during the period of this study it was possible to reduce cannibalism to a low level in this species by giving special food; and the results of the study on its breeding habits in captivity are presented in this paper.

### MATERIAL AND METHODS

Twenty new born young with their mothers were dug out from fields during March to May, 1965. These were kept in breeding cages measuring $45 \times 30 \times 22 \cdot 5$ cm. made of strong wire netting. The bottom of each cage was provided with a sliding metal tray for collecting faeces and urine. To provide darkness and privacy the cages were painted black,

TABLE 1

BREEDING PATTERN OF SIX PAIRS OF FIELD RAT, *Millardia meltada* (GRAY) IN CAPTIVITY

| | Pair Number | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| [1]Approximate date of birth of parents .. | 18.3.65(♀) 5.5.65 (♂) | 20.4.65 | 25.4.65 | 25.4.65 | 5.5.65 | 5.5.65 |
| Date of pairing .. | 2.6.65 | 2.6.65 | 2.6.65 | 2.6.65 | 2.6.65 | 2.6.65 |
| *Ist Litter :* | | | | | | |
| Date .. | 23.8.65 | 25.8.65 | 14.8.65 | 26.3.66 | 21.8.65 | 29.8.65 |
| Number .. | 5 | 3 | 3 | 4 | 2 | 2 |
| *IInd Litter :* | | | | | | |
| Date .. | 16.9.65 | 26.3.66 | 18.9.65 | 16.4.66 | 26.3.66 | 9.4.66 |
| Number .. | 3 | 6 | 4 | 2 | 2 | 3 |
| *IIIrd Litter :* | | | | | | |
| Date .. | 26.3.66 | 15.4.66 | 17.3.66 | Female died | 6.5.66 | 20.5.66 |
| Number .. | 5 | 4 | 2 | on 11.6.66 | 1 | 3 |
| *IVth Litter :* | | | | | | |
| Date .. | 7.8.66 | 6.5.66 | 17.9.66 | — | 27.9.66 | 28.7.66 |
| Number .. | 4 | 4 | 2 | — | 1 | 4 |
| *Vth Litter :* | | | | | | |
| Date .. | 29.8.66 | Male died on | — | — | — | 18.8.66 |
| Number .. | 8 | 13.6.66 | — | — | — | 4 |
| *VIth Litter :* | | | | | | |
| Date .. | 26.9.66 | — | — | — | — | 10.9.66 |
| Number .. | 3 | — | — | — | — | 4 |
| *VIIIth Litter :* | | | | | | |
| Date .. | — | — | — | — | — | 1.10.66 |
| Number .. | — | — | — | — | — | 5 |

[1] The parents were field collected young and their dates of birth were estimated on the basis of the condition at the time of capture.

placed on racks and curtained. They were fed on gram flour enriched with multivitamins, ostocalcium and sugar at the rate of 2, 2 and 10 per cent, respectively. The quantity of food and water provided was always in excess of their requirements and food was renewed every day. The mother rats were removed as soon as their young started feeding on flour bait. Only 15 (7 males and 8 females) of the 20 young survived up to 2 June, 1965, when pairing was done. Thus, 7 pairs were made and the extra female was discarded. In 6 out of the 7 pairs, siblings were paired. Each pair was placed in a cage of the dimensions mentioned above. The young produced by each pair were allowed to remain in the same cage until they started feeding on the flour bait, when they were separated and placed in a different cage.

## Results and Discussion

Out of the seven pairs, one pair died on 23 July, 1965, without producing a single litter. The breeding records of the remaining 6 pairs are presented in Table 1. The young born in captivity to rats of first generation in the month of August were paired in the month of October, and their breeding behaviour is given in Table 2.

Table 2

Breeding in second generation *Millardia meltada* in captivity

| Sr. No. | Date of birth | Date of pairing | Date of litter production | Number of young in the litter |
|---|---|---|---|---|
| 1. | 23.8.65 | 23.10.65 | 15.4.66 | 4 |
| 2. | 21.8.65 | 23.10.65 | 18.4.66 | 6 |

*Breeding Seasons :* As seen in Table 1, litters were produced in two breeding periods : (i) from March to May and (ii) from August to October. These findings are in agreement with those of Deoras (1964) who maintains that in Bombay rats breed mainly during the hot months, one peak being during August to October and the other during March to May. This is also supported by the findings of Singh (1961) who found that in the field, the young of *Tatera indica* are available with their mothers in the months of March to May and again in October to November.

*Number of litters and young per litter :* In each breeding period *M. meltada* reproduced 1 to 4 times—a female produced a maximum of 3 litters during March to May and 4 litters during July to September,

Thus, the number of litters in an year may range from 2 to 7. This observation is similar to that of Burton (1962) who reported that in a year *Rattus rattus* and *Rattus norvegicus* produced 5 to 6 litters and 6 litters, respectively.

TABLE 3

APPROXIMATE GESTATION PERIOD IN THE FIELD RAT, *Millardia meltada*

| Sr. No. | Date last litter | Date next litter | Approximate gestation period (Days) |
|---|---|---|---|
| 1. | 23.8.65 | 16.9.65 | 24 |
| 2. | 14.8.65 | 18.9.65 | 35 |
| 3. | 26.3.66 | 15.4.66 | 20 |
| 4. | 26.3.66 | 16.4.66 | 21 |
| 5. | 26.3.66 | 6.5.66 | 41 |
| 6. | 9.4.66 | 20.5.66 | 41 |
| 7. | 15.4.66 | 6.5.66 | 21 |
| 8. | 28.7.66 | 18.8.66 | 21 |
| 9. | 7.8.66 | 29.8.66 | 22 |
| 10. | 29.8.66 | 26.9.66 | 28 |
| 11. | 18.8.66 | 10.9.66 | 23 |
| 12. | 10.9.66 | 1.10.66 | 21 |

During this laboratory study the 6 pairs produced 93 young in 27 litters and the number of young ones per litter varied from 1 to 8, the average being 3·44; whereas in field collections each of 6 litters contained 5 to 8 young, the average being 6. These numbers are quite comparable with 7 to 8 young per litter in case of *R. norvegicus* (Perry 1945) and 6 young per litter in case of *R. rattus* (Watson 1951). In all cases, the females gave birth to the young at night. This finding is in line with that of Snell (1941).

*Gestation period:* Mating was not observed because it might be occurring at night or for extremely short intervals if it occurred during the day. Also no chemical pregnancy tests were carried out to determine the gestation period. However, the data presented in Table 3 indicate that the minimum period elapsing between the dates of production of two consecutive litters was 20 days. This means that the gestation period was 20 days or even shorter than this. This is comparable with the figure (21 days) given by Clegg & Clegg (1963) for rats in general and 20 to 26 days in *R. norvegicus* and 21 to 30 days in *R. rattus* reported by Burton (1962).

*Maturity :* Out of the 20 field collected young the 6 females that were used for the study of breeding habits, produced their first litter after 158, 127, 111, 335, 108 and 116 days respectively and considering that the

gestation period is about 20 days, the probable time taken to attain sexual maturity in these six cases works out to 138, 107, 91, 315, 88 and 96 days, respectively. Thus, in case of young born in the months of March to May the time taken to attain maturity varied from 3 to 4½ months with the result that irrespective of the month of their birth all the 6 females born in the March to May breeding season produced their first litter during August the same year. However, there was one exception wherein the female produced its first litter only after 334 days or 11 months (Table 1). The two females born in the laboratory during August and paired in October produced their first litter in the following April i.e. after a period of 215 and 220 days or approximately 7 months (Table 2).

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LUDHIANA.
*January* 3, 1967.

O. S. BINDRA
PREM SAGAR

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## 4. NEW RECORDS OF MAMMALS FROM RAJASTHAN, INDIA

Since the publication of the recent authoritative literature on the distribution of Indian Mammals by Pocock (1939, 1941), and Ellerman & Morrison-Scott (1951), several new records of mammals have been made by Prakash (1956, 1957, 1959, 1961, 1963*a*, 1963*b*, 1964) and Agrawal (1967) from Rajasthan. The recent mammalian collections made in Rajasthan by various parties of the Rajasthan Desert Survey of the Zoological Survey of India include examples of two species of mammals,

which are yet unreported from that State. While the detailed taxonomic discussion on this material will be considered in a later paper, we have thought it worthwhile to publish the new mammalian records hereunder.

**Pipistrellus mimus mimus** Wroughton. The Indian Pygmy Pipistrelle (Chiroptera : Vespertilionidae).

Material examined : 10 ♂♂ (2 subad.), 6 ♀♀ (2 subad.) and 2 unsexed from Nagaur District (Gudha, Lihora, Nawa) ; April and August, 1958.

According to Wroughton (1918) and Ellerman & Morrison-Scott (1951), it occurs over a wide territory from Ceylon to Kathiawar in the south, and in the north from Kumaon to western Burma, and Annam in the east. The present material appears to constitute the first report of this subspecies from Rajasthan.

**Herpestes edwardsi nyula** Hodgson. The Indian Grey Mongoose (Carnivora : Viverridae).

Material examined : 1 ♀ from Marwar District (Pali) ; December, 1956.

According to Pocock (1941) and Ellerman & Morrison-Scott (1951) *Herpestes edwardsi ferrugineus* Blanford occurs in Rajasthan which is its eastern limit. Westward it occurs up to Iraq through parts of north-western India, Sind, Baluchistan and Iran. The present specimen of *H. e. nyula* which has so far been known from Kutch to Bengal south of the river Ganga and Nepal to Assam north of that river (Pocock, 1941, Ellerman & Morrison-Scott, 1951), constitutes the first authentic record of this subspecies from Rajasthan.

Examples of *H. e. ferrugineus* in the collection of the Zoological Survey of India are from the northern, north-western and western parts of Rajasthan, while *nyula* is known from the south-eastern region.

Zoological Survey of India,
Indian Museum,
Calcutta-13.
*February* 22, 1968.

BISWAMOY BISWAS
R. K. GHOSE

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## 5. ON THE FOOD HABITS OF CORMORANTS IN THE BREEDING SEASON

Every year a good number of Cormorants (*Phalacrocorax* sp.,) Night Herons (*Nycticorax nycticorax*), and Anhingas (*Anhinga melanogaster*) assemble in the trees within the Calcutta Zoological Gardens for nidification. Night Herons seem to be permanent residents while cormorants and anhinga frequent the garden only during breeding season. The cormorants begin to assemble in the beginning of May. The population attains a peak during the breeding months from June to September. By the end of October most birds leave although some are seen even in early December. We had the opportunity of examining the nest loads of dry fish and stomach contents of young birds when a few branches had to be cut down, thus bringing down hundreds of nest and young ones.

On the basis of this examination it is evident that the birds consume a lot of fish which forms their main food during the season. The following fishes could be identified.

1. *Tilapia* (67% of total)
2. Major carps (27% of total)
3. *Ophicephalus* (6% of total)

Very small fishes were found in the crops of very young birds. The biggest fish brought were in the weight range 23-32 gm.

The highest values of weight are given below :—

| | |
|---|---|
| *Tilapia* | 31 gm. |
| *Labeo rohita* | 27 ,, |
| *Ophicephalus* | 32 ,, |

These data show that *Tilapia* forms the major item of consumption during breeding season perhaps because this species is plentiful and is a surface-dweller. It is well known that tilapia breed at a very rapid rate so that ultimately we have a very large number of very small fish which are not of marketable size. Various schemes have been suggested for weeding out its excessive number. In nature cormorants may act as such balancing agents.

We are deeply grateful to Sri R. K. Lahiri, Superintendent, Calcutta Zoo Gardens for his sincere co-operation.

ZOOLOGY DEPARTMENT,
BRAHMANANDA KESHAB CHANDRA COLLEGE,
BON-HOOGHLY,
CALCUTTA-35.

A. R. SENGUPTA

INDIAN STATISTICAL INSTITUTE,
CALCUTTA-35.

R. L. BRAHMACHARY

*September* 10, 1967.

## 6. GREYHEADED LAPWING *VANELLUS CINEREUS* (BLYTH) : NEW RECORD FOR RAJASTHAN

I saw three Greyheaded Lapwings along with Wood Sandpiper, and Redwattled Lapwing at the water's edge within the Ghana Sanctuary, Bharatpur (27° 13′N., 77° 32′E.) on 20 January 1968. The known winter range of this migrant, in the Indian region, is Kashmir, Bihar, Assam, East Pakistan and the Andamans.

The birds were seen at 4.30 p.m. in bright light, through field glasses at close quarters. All the features including the colour of the irides could be clearly noted. The pectoral band was considerably dark in one individual, and in another it was very faint.

BOMBAY NATURAL HISTORY SOCIETY,
HORNBILL HOUSE,
BOMBAY.
*March* 23, 1968.

B. ROBERT GRUBH

[Winter visitor. Quite common in Assam, Manipur, and East Pakistan ; also in Kathmandu Valley, Nepal. Occurs in N. Bihar, and stragglers recorded in Kashmir, Dehra Dun, and the Andaman Islands. A large proportion of our visitors are young birds without the pectoral band (Sálim Ali & Ripley, HANDBOOK)—Eds.]

## 7. ON THE OCCURRENCE OF THE BLACKSHAFTED LITTLE TERN (*STERNA ALBIFRONS SAUNDERSI* HUME) NEAR BOMBAY

In 1964 [Races of *Sterna albifrons* Pallas in India and Pakistan (*J. Bombay nat. Hist. Soc.* **61** : 440-446)], Humayun Abdulali had referred to the absence of records of the Blackshafted Little Tern *Sterna albifrons saundersi* Hume, south of the Gulf of Kutch.

On 10 April 1967, I saw several Little Terns in Dharamtar Creek, Kolaba District, a few miles south of Bombay, and the two specimens obtained are of this race, presumably on their way towards their breeding grounds around Karachi.

All three races *sinensis* (breeding), *albifrons* and *saundersi* have now been recorded from our area.

ST. XAVIER'S HIGH SCHOOL,
BOMBAY.
*January* 9, 1968.

A. NAVARRO, S.J.

## 8. PARENTAL INSTINCTS IN KOEL *EUDYNAMYS SCOLOPACEA* (LINNAEUS)

On 25 July 1965 at about 4.45 p.m. I located a crow's nest on a neem tree on the outskirts of Rajpipla thickly overgrown with trees. The river Karjan was about a furlong from the tree with the nest. To have a better view of the nest I climbed on a higher branch of a nearby banyan tree.

The nest was occupied by an adult crow (*Corvus splendens*) which perched on the edge of the nest, facing me and thus obscuring my view of the nest's interior. Another adult crow was perched on a nearby branch. This evidently was the parent pair.

At 5.15 p.m. the bird away from the nest gave a low *Caa. . . .rr. . . . aww* and flew off in the direction of the river. After a minute or two the bird on the nest also flew off in the same direction, perhaps to quench their thirst in the river.

In about a couple of minutes I heard a flutter of wings above my head and saw a female koel (*Eudynamys scolopacea*). It had something in its beak, probably an insect. I paid no further attention to her presence.

I saw through my binoculars that the crow's nest held four nestlings of which one was slightly larger and already had some feathers. As I watched the nest the koel approached it very cautiously, and was soon on its edge. The insect still held in its beak was now identified as a grasshopper. The nestlings reacted to her approach with outstretched necks and wide open beaks.

The koel cautiously scanned the surroundings for the sudden approach of the rightful owners of the nest and being satisfied of its safety fed the largest nestling and started pecking at the other nestlings. It also started pushing them to the edge of the nest, with perhaps the intention of throwing them out of the nest. The frightened nestlings started calling, the koel nestling was also pushing the crow nestlings off the nest.

The cries of the nestlings brought the furious parents and the koel busy attacking the crow nestlings was caught redhanded. The crows pounced upon the koel and all three went tumbling down the branches and somehow, the koel managed to escape and fled from the scene with one of the crows in hot pursuit, while the other returned to the nest and started inspecting the nestlings. After being satisfied it settled down in the nest, preening its feathers and setting them right after the rough fight. After a while, the other crow returned, evidently after a fruitless pursuit. I kept watch on the same nest for three more days, but nothing unusual occurred.

My observations indicate that the koel may have a certain amount of instinctive desire to feed its young.

I also feel that the adult koel's efforts to throw off the crow nestlings was an extension of the instinct in koel nestlings to do away with other nestlings and eggs in their nest. This conclusion has added support as it has been observed that when a koel lays its eggs in the host nest, she also removes other eggs from the nest. It has been observed and recorded that koel do feed their offsprings that have left their nest.

This incident also definitely shows that the koel shows some interest in parental care, and is not completely devoid of the instinct of parental care.

Several problems require answers. Does the koel recognise its young after the long period of incubation? Whether the young was her own or the nest was a completely different one and the koel acted merely instinctively? Did the koel keep track of the nest in which she laid her egg so that she could recognise her young after hatching? Whether the male has any trace of parental instinct?

I am sure, these questions will encourage readers to be on the lookout for crows and the koel.

### Acknowledgements

I am indebted to the University Grants Commission for awarding a research grant which made this work possible. I am also indebted to Dr Sàlim Ali, for his suggestions. Thanks are also due to the Secretary, Adiwasi Kelavani Mandal, Rajpipla, for offering all possible help.

Department of Biology,
M.R. Arts and Science College,
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DHRUV DIXIT
*July* 23, 1967.

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## 9. BLACKCAPPED KINGFISHER *HALCYON PILEATA* (BODDAERT) AT BHARATPUR, RAJASTHAN

During the Bombay Natural History Society's Bird Migration Study Project (1967-68) at Ghana Bird Sanctuary, Bharatpur (27° 13′N., 77° 32′E.) a Blackcapped Kingfisher was caught in our net on 9 Feb. 1968. This specimen was preserved and bears Reg. No. 22931 of the Society's bird collection. Another bird was seen in the same area later.

This bird is usually seen along the coasts and has not been recorded so far inland in western India though in the east it is known from Monghyr (Bihar) on the Ganges and eastern Assam.

BOMBAY NATURAL HISTORY SOCIETY,
HORNBILL HOUSE,
BOMBAY.
*March* 23, 1968.

B. R. GRUBH
J. D. PANDAY
P. B. SHEKAR

## 10. CROWS AND COMPANIONSHIP

(*With a text-figure*)

On the evening of 29 December 1965, I and my friend Rojer Finzel of the American Peace Corps stationed at Rajpipla were sitting on the terrace of my house when we saw an unusual sight, a crow (*Corvus splendens*) with a broken upper beak as in the text-figure.


We were wondering as to how it would feed itself. After watching it for a while I decided to take its photograph, and went into the house but on returning with the camera I was disappointed to notice that the crow had flown off.

On the morning of 31 December at about 7.30 a.m. I saw the bird again. It was trying to feed itself by bending its head to one side and scooping the food with the lower beak. It failed several times in its efforts to secure the food but in the end managed to place it on the lower beak and tilting its head upwards as birds do to drink water, swallowed the food with slow jerky movements.

When it was trying again to pick up another bit a couple of crows nearby came and started feeding it. This led me to the hasty conclusion

that the bird was young but more careful observation confirmed that it was an adult. This indicates a sympathy towards a crippled member of the flock. However, a more plausible explanation could be that this bird lost its upper beak as a nestling and the pair that had fed it as a nestling continued to feed it considering its helplessness.

I shall be very much interested in any similar incident recorded.

DEPARTMENT OF BIOLOGY,
M.R. ARTS AND SCIENCE COLLEGE, DHRUV DIXIT
RAJPIPLA.
*July* 23, 1967.

## 11. THE WAXWING, *BOMBYCILLA GARRULUS* (LINNAEUS), IN NEPAL

The Waxwing, *Bombycilla garrulus* (Linnaeus), has been reported in southern Asia from Quetta and Bannu in extreme western Pakistan (Ripley 1961 : 319). Recently I undertook a study trip with members of the Natural History Society of Woodstock School, Mussoorie, U.P. to the Gosainkund Lekh region north of Kathmandu. On the morning of 16 December 1967, Mr. Robert Waltner, Staff Advisor to the Society, reported seeing a solitary ' waxwing-like ' bird near our camp at Thare Pate Puchari. Later the same day I found a flock of four waxwings perched in the top of a bare tree at *c*. 3660 m. (12,000 feet) elevation ; two were collected.

These birds were in association with Whitewinged Grosbeaks, *Mycerobas carnipes* (Hodgson), and Blackthroated Thrushes, *Turdus ruficollis* Pallas, in a mixed forest of *Juniperus*, *Rhododendron*, *Magnolia* and *Abies*. The only note heard was the familiar high ' *zeeee zeeeee* ' given when the birds were about to fly. The ventriculi of the two birds contained whole juniper berries (probably of *Juniperus recurva*, see Stainton, 1964 : Appendix E). Measurements of the specimens were : RLF 2131 : ♀, wing 116 mm.; RLF 2132 : ♀, wing 114 mm.

### ACKNOWLEDGEMENTS

Dr. R. L. Fleming, Sr., helped greatly in making arrangements for our trip. I also wish to express my thanks to the officials of the Foreign Office and Forest Department of His Majesty's Government for permission to trek and collect in Nepal.

OFFICE OF ECOLOGY,
SMITHSONIAN INSTITUTION, ROBERT L. FLEMING JR.
WASHINGTON, D.C. 20560.
*December* 23, 1967.

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## 12. EXTENSION OF RANGE OF ISABELLINE CHAT *OENANTHE ISABELLINA* (TEMMINCK)

On 5 November 1967 we obtained, in open scrub by the side of Matoba Tank near Yewat, Dhond Taluka, Poona, a bird which by appearance and behaviour seemed to be a Desert Wheatear (*Oenanthe deserti*), except that when once it settled under a 'Tarwad' (*Cassia auriculata*) bush its upright stance suggested a pipit rather than a chat. Upon closer examination it proves to be a female Isabelline Chat, *Oenanthe isabellina* (Temminck).

*O. isabellina* is accepted as a common migrant through the north-west. Butler (1880) in A CATALOGUE OF THE BIRDS OF THE SOUTHERN PORTION OF THE BOMBAY PRESIDENCY, says: 'Rare. Occurs as a straggler about Nagar. I have no other record of its occurrence within the region'. Blanford (1890)[1] accepts it as far south as Ahmednagar (Nagar), slightly north of the present locality, but this is omitted in subsequent literature, the southern limit being given as a line from North Gujarat, east through Sehore (Bhopal) to Banares, in Ripley's SYNOPSIS. This also (correctly) ignores a female *deserti* collected by Sâlim Ali at Bhyander, Thana District, Bombay, and listed (BNHS Reg. No. 2587) under *O. isabellina*.

In the hand, the heavier bill, the longer tarsus (29 mm.), the white (and not buff) upper-tail coverts, and the generally bulkier appearance clearly separate *isabellina* from female *deserti* and some of these differences may be noticeable in the field. The male *deserti* is of course quite different.

BOMBAY NATURAL HISTORY SOCIETY,
HORNBILL HOUSE,
BOMBAY-1.
*November* 13, 1967.

HUMAYUN ABDULALI
R. J. PIMENTO

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[1] BLANFORD, W. T. & OATES, E. W.: The Fauna of British India. Birds **2**: 77.

## 13. GREYWINGED BLACKBIRD *TURDUS BOULBOUL* (LATHAM) AT BHARATPUR, RAJASTHAN

We saw a male Greywinged Blackbird in the Ghana Bird Sanctuary, Bharatpur (27° 13′N., 77° 32′E.) in the afternoon of 25 February 1968. The bird, which settled on a low tree, was not shy and could be approached as near as 25 feet. Its black plumage with prominent grey patch running from part of the wing coverts to the inner secondaries, and the finely barred abdomen, together with reddish orange bill and yellow eye lids leave no doubt as to its identity. It was seen on three successive days in the same area.

This species has not been recorded south of the Punjab Salt Range where it is noted as 'occasionally straggling in winter' by Ripley (1961).

BOMBAY NATURAL HISTORY SOCIETY,
HORNBILL HOUSE,
BOMBAY.
*March* 23, 1968.

B. R. GRUBH
P. B. SHEKAR
J. D. PANDAY

### REFERENCE

RIPLEY, S. D. (1961): A Synopsis of the Birds of India and Pakistan: 532, Bombay Natural History Society, Bombay.

## 14. THE GREEN ALGA, *SPIROGYRA* SP. IN THE DIET OF THE WHITEBACKED MUNIA, *LONCHURA STRIATA* (LINN.)

On the morning of 9-IX-1967, while crossing a rice field in process of conversion into a housing site in the eastern outskirts of Ernakulam, my path lay over uneven ground thrown into a series of hollows and depressions which were filled up during the recent rains. As I neared one of them in which the water had nearly dried up, a small party of whitebacked munias suddenly flew down from their perch on the nearest telegraph wire and were seen to peck at the green algae which had formed on its exposed moist bed. From where I stood hardly 6 feet away, I could clearly see a green strand of the alga in the beak of the bird nearest to me, slowly being swallowed. The other birds hopped about on the sandy bottom, pecking at the green mass and seemingly enjoying themselves. However, before I could continue with my observation, the sound of approaching footsteps disturbed the birds and sent them scurrying from their meal.

The green alga struck me as rather an unusual item in the diet of this munia, which along with others of its tribe, is known to feed chiefly on seeds and grains. Whether or not this choice of food is commoner than

just accidental, only further observations will show. Perhaps some of the readers of your esteemed *Journal* may have had a similar experience? The algal slime found in the depressions was identified as *Spirogyra* sp. with an admixture of diatoms by Prof. S. Iyer, Head of the Department of Botany, The Maharaja's College, Ernakulam, to whom my grateful thanks are due.

' BELLE-VUE'
DEWAN'S ROAD,
ERNAKULAM.
*November* 13, 1967.

N. G. PILLAI

## 15. OCCURRENCE OF THE SNAKE *TYPHLOPS DIARDI* SCHLEGEL IN THE DUN VALLEY

I collected two specimens of *Typhlops diardi* Schlegel from (Reg. No. V229) Dharmawala Forest Block, Timli Forest Range, Dehra Dun Forest Division, Dehra Dun District, on 9 March, 1963, and a female (Reg. No. V 230) from a drain near Garhi Cantonment, Dehra Dun, on 10 June, 1964. The species has not been recorded earlier from the Western Himalayas.

The specimens show some variation in the lepidosis from that given by Smith (1935) FAUNA OF BRITISH INDIA, Reptilia and Amphibia, **3**: 52 ' eye distinct, usually in the ocular shield, the lower edge of which is wedged in between 3rd and 4th labial'. The eyes are distinct in the ocular shield and the lower edge of the ocular is not wedged in between 3 and 4 supralabials, but the ocular touches the 4th supralabial.

The female specimen contained 9 fully developed eggs of 4-7 mm. size. It appears that the egg laying season commences in June in the Dun Valley.

Smith (op. cit.) gives the range of *T. d. diardi* as ' Bengal, Assam, Burma and French Indo-China north of lat. 16°'. The present record of the species from Dun Valley considerably extends the western range of the species.

NORTHERN REGIONAL STATION,
ZOOLOGICAL SURVEY OF INDIA,
DEHRA DUN.
*May* 26, 1966.

R. K. BHATNAGAR

## 16. UNUSUAL BEHAVIOUR OF TWO MALE RAT SNAKES, *PTYAS MUCOSUS* (LINN.)

On 8 May, 1966 we saw two Rat Snakes, *Ptyas mucosus* (Linn.) twined around each other, on a grassy patch of land at Rajpur. Though a crowd had gathered around them the snakes remained twined with the fore-body raised approximately 2 to 3 feet above ground and swaying to and fro. When first observed, we thought that the snakes were mating, but the everted hemipenis disproved this assumption. Later the snakes were shot by one of us (A.K.B.) but by the time we could bring a collection bag the watching crowd had started a fire to ward off the supposedly bad omen! However, the specimens were saved and later deposited in the Northern Regional Station of the Zoological Survey of India, Dehra Dun.

Neither Smith (1935) nor Wall (1906) have reported such unusual behaviour in the species. However, Abdulali (1941) who has observed similar behaviour, states ' the chances are that the males were fighting but no attempt was made to bite each other. It might be interesting to examine other pairs of snakes apparently in coitus '. Though the snakes we saw were swaying their bodies and occasionally hissing, yet no attempt was made to bite or to tighten the coils around each other. This behaviour is certainly unusual and apparently rarely seen, otherwise there would certainly have been numerous reports in the *Journal.*

I/C 14 SURVEY PARTY,
4, CONVENT ROAD, DEHRA DUN. A. K. BHATTACHARYA

NORTHERN REGIONAL STATION,
ZOOLOGICAL SURVEY OF INDIA, R. K. BHATNAGAR
' RUSHMI ', 13-SUBHASH ROAD,
DEHRA DUN.
*June* 2, 1966.

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SMITH, M. A. (1935): Fauna of British India: Reptilia **3**: 159.

WALL, F. (1906): A popular treatise on Common Indian Snakes. Part III. *J. Bombay nat. Hist. Soc.* **17**: 259-273.

[The exact significance of this behaviour known as ' combat dance ' is not clear. It is thought that it may be due to sexual or territorial rivalry. This behaviour, though well known among some rattle-snakes (Crotalidae) and an Australian elaphid, has been recorded only for the rat snake among Indian snakes.—EDS.]

## 17. A NOTE ON THE FOOD AND FEEDING HABITS OF TOR MAHSEER, *TOR TOR* (HAMILTON) FROM RIVER NARMADA[1]

*Tor tor* (Hamilton), popularly known as Tor Mahseer is one of the game fishes of India. This species ranks first in the commercial catches of River Narmada near Hoshangabad and constitutes about 28·0% in the total landings and 47·0% in the carp fishery. It attains a maximum length of 4 feet (Hora 1940 and MacDonald 1948), but the largest specimen recorded from River Narmada at Hoshangabad measured 2 feet and 10 inches. As, in recent years, the culture of Mahseer fry in confined waters has been attempted for sport fishing and cultural purposes, knowledge of the natural food of Mahseer is essential. Though Hora (1940), Codrington (1946) and MacDonald (1948), among others have contributed on the bionomics and natural history of Tor Mahseer, detailed information on its food and feeding habits are so far lacking. Detailed observations on the food of this fish were therefore made at the Narmada Tapti Unit of the Central Inland Fisheries Research Institute at Hoshangabad. A preliminary statement of these observations is given in the present note.

The gut contents of 577 specimens (size range : 200-790 mm.) of this fish were analysed by eye estimation and occurrence method.

The fish mainly subsists on macrovegetation (48·5%), algae (14·5%), molluscs (10·5%) and insects (8·3%). The macrovegetation comprises a variety of submerged plants like *Vallisneria* including its seeds (8·7%), various kinds of grass (6·9%), *Naias* (2·5%), *Ceratophyllum* (1·2%), *Hydrilla* (0·4%), unidentified plants (1·6%), twigs (2·4%), roots (0·3%) and digested plant matter (24·5%). These items form the bulk of gut contents throughout the year. The algal food is formed by the filamentous and branched algae like *Spirogyra* (8·9%), *Chara* (2·5%), *Pithophora* (0·8%), *Mougeotia* (0·6%), *Zygnema* (0·5%) and unidentified semi-digested algae (1·2%). The molluscs are represented by *Corbicula striatella* (7·7%), *Indonaia caerulea* (0·2%) and *Parreysia favidens* (0·1%) among pelecypods (8·0%) and *Viviparus bengalensis* (2·0%) and *Melanoides* (*Tarebia*) *lineatus* (0·5%) among gastropods (2·5%). The aquatic insects which comprise mostly bottom dwelling insect larvae are represented by orders Trichoptera, mostly caddisworms (3·7%) ; Diptera, mostly *Chironomus* larvae (2·1%) ; Ephemeroptera, only nymphs (0·6%) ; Odonata, Dragonfly nymphs (0·4%) ; Hemiptera, adult water bugs and

[1] Published with the permission of the Director, Central Inland Fisheries Research Institute, Barrackpore (via Calcutta).

water boatmen (0·4%); and Coleoptera, both adults and larvae (0·1%). The digested insect matter made up 1.0% in the gut contents.

Besides these principal food components, the other items which are incidentally taken by the fish while feeding at bottom are fish remains consisting of bones and scales (0·2%), miscellaneous animal matter comprising crabs, crustacean appendages and centipedes (0·2%), debris consisting of cloth, paper, stone and charcoal pieces (7·9%) and sand and mud (7·8%). Smaller quantities of sand are also contributed by the crushed cases of caddisworms. The presence of fully and semi-digested plum fruit, (2·1%) in some of the guts is attributed to feeding of fish by the fishermen to lure them to fishing grounds.

It feeds voraciously from November to June (av. gastrosomatic index: 4·23). The feeding intensity of this fish is poor from July to October (av. gastrosomatic index: 1·78) which coincides with its breeding season.

The composition of the diet of Tor Mahseer clearly indicates that it is a marginal bottom feeder and is mainly herbivorous (macrovegetation and algae: 63·0%) and carnivorous to a lesser degree (molluscs and insects: 18·8%) in feeding habits. Hora & Mukerji (1936) also stated that Tor Mahseer [*Tor tor* (Hamilton) = *Barbus tor* (Hamilton)] feeds 'preferably on filamentous algae and water plants'.

The protrusible and suctorial mouth of the fish and the presence of large quantities of sand, mud and debris (15·7%) in the guts are suggestive of bottom feeding habits. The marginal shallow portions of river bed where the water current is feeble are densely covered with submerged rooted vegetation and algae which invariably harbour insects, molluscs and other biota. While 'grazing' at the river bottom, the fish ingests macrovegetation and algae, along with insects and molluscs dwelling among them, and other bottom biota.

On the basis of herbivorous feeding habits of 'Katli', *Barbus* (*Lissochilus*) *hexagonolepis*, Saha & Sen (1956) have indicated its utility in the biological control of submerged aquatic vegetation in ponds. Since Tor Mahseer feeds extensively on underwater rooted vegetation and algae in its natural habitat, it is regarded as a true herbivore and could be used for the biological control of submerged weeds. Being a native species, the possibilities of using Tor Mahseer for successful biological control of weeds in ponds are worth exploring in India and intensive studies may be undertaken to evaluate its suitability as an effective weed control agent.

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## 18. A CASE OF ALBINISM IN *HETEROPNEUSTES FOSSILIS* (BLOCH)

An immature albino specimen of *Heteropneustes fossilis* (Bloch) was obtained from a pond at Joysagar Fish Farm, Assam in the month of April, 1965. The entire body of the fish was white with a bluish patch on either side of the body behind pectoral fin. The colour of the eyes, even in living condition of the specimen was also white. Each eye had a slightly dark ring at the periphery caused probably by the colour of the internal tissue. The albino measured 131 mm. in length and weighed 14·6 gm. Abnormality neither in external nor internal organs of the albino was observed.

Albinism in fish is uncommon and has been described only in a few cat fishes and in an eel. Hora (1926) has recorded partial albinism in Magur, *Clarias batrachus* (Linn.). Other instances of albinism are recorded by Dean (1923) in *Clarias angularis* and *Silurus* sp. and by Aitkin (1937) in *Ictalurus punctatus.* Jones & Pantulu (1952) have described albinism in the freshwater eel, *Anguila bengalensis.* Gupta & Bhowmic (1958) recorded an albino *Arius jella* Day. The occurence of albinism in *Heteropneustes fossilis* (Bloch) forms another record of this phenomenon among cat fish so far recorded in India.

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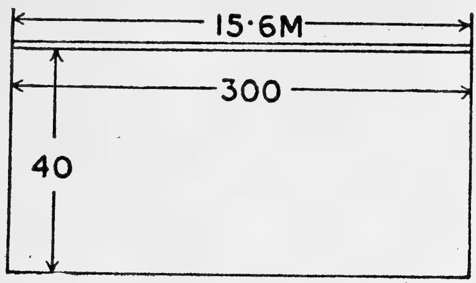
## 19. ON THE INTRODUCTION OF *PHASLA JAL*, A GILL NET, FOR CATCHING *HILSA* IN THE GANGA AND YAMUNA NEAR ALLAHABAD

(*With a text-figure*)

A detailed account of the fishing nets and traps employed in a section of the middle reaches of the Ganga River System, during 1963 has been given by Saxena (1966). At that time he reported, that gill net was not used in this stretch for catching *Hilsa*, although major carps and cat-fishes were being caught with gill nets, such as *Tiar* and *Gochail*. Jones (1959 a & b) while describing fishing gears used for the capture of *Hilsa*, has also not recorded this gear. The net described here has been recently introduced in the Ganga and Yamuna near Allahabad reportedly during 1964. Lightness, convenience for operation, better yield with less effort are the advantages of this net. Probably because of these, the net has gained popularity in this region within a very short period, in spite of the high initial cost owing to nylon being used in its fabrication. The cost of the net comes to approximately fifty rupees.

Made of nylon twine of varying thickness, a single piece of the net commonly known as *Phasla Jal*, has 280-300 meshes across and 40-50 meshes in depth. The head rope, usually 1-2 mm. in thickness and made of either nylon or cotton, measures 15·62 m. in length. Floats, made of several thin reeds joined together and measuring 13·5 cm. in length and 4 mm. in diameter, are tied to the head rope at intervals of 38·5 cm. leaving about 10 meshes free in between every two floats. Usually one mesh is left free along the length of the float (Figs. 1 and 2). Two to three such pieces are usually joined together in operation. The most common mesh sizes encountered are 8·5 cm., 9·0 cm. and 10·5 cm. (stretched). Sometimes pieces of different mesh sizes are also combined together for catching different size groups. The net is quite often dyed blue probably as a camouflage. A notable feature of the net is the complete absence of the bottom rope and sinkers.

Two men and a small boat (*dongi*) are required to operate this net. The net is payed out across the river where the current is sluggish. Ascen-

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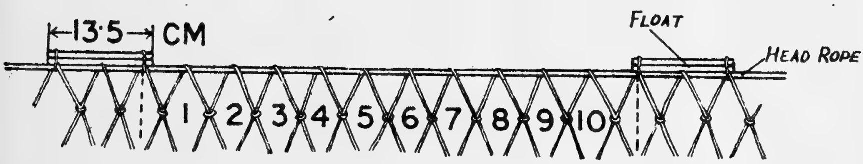


2

Fig. 1. A single piece of *Phasla Jal.*

Fig. 2. Showing arrangement of floats and meshes.

ding or descending *Hilsa* trying to pass through the body of the net get gilled. Often they get enmeshed in the net due to its loose lower margin. The enmeshed fish are taken out immediately, so that the effective catching area of the net is not reduced for subsequent catches. *Phasla* is operated throughout the year except during the monsoon months, when fast currents prevent its operation. The net is operated both in the Ganga and Yamuna where the required depth and current occur during the greater part of the year. The net is usually operated during night.

*Phasla Jal* of bigger mesh-size (19·0-20·00 cm.) and made of thicker nylon fibre is used for catching major carps and catfishes. *Phasla Jal* resembles the *Tiar* of Ganga, *Rangoon-vala* of Andhra, *Ulla-valai* of Madras and *Amyaw-paik* of Burma.

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## 20. FOOD HABITS OF THE BULL FROG *RANA TIGERINA* (DAUD.)

A good deal of literature is available on the natural food of the Indian Bull Frog, *Rana tigerina* (Daud). The reported observations could be conveniently put under two heads, direct observations while feeding and those based on examination of gut contents. Aitken (1895), Gostling (1895), Whiffin (1895), Sundera Raj (1915), Davidson (1916), Zutshi (1926), McCann (1933), Rao & Cherian (1940), Dharmakumarsinhji (1940), and Bhaduri (1945) have made direct observations while Chibber (1911), Agharkar (1912), Mullan (1912), Mahendra (1929), Iswar Prakash (1953), and Wadekar (1963), studied the gut contents. The direct observations give us knowledge of the food, the feeding mechanism, defence of the prey, etc., but considering the food factor direct observations are usually isolated cases of unusual rather than normal food, whereas the records of the gut contents show the overall picture of the general diet.

The present data is based on the gut-contents of frogs made available for dissections to students. The data is based on material collected from 100 selected frogs received during the period of 14th July 1961 to 29th August 1961. After killing with chloroform, the frogs were weighed, sexed and frogs with enlarged belly were dissected out to collect the stomach contents. Frogs showing even little stomach contents were taken into account.

The major contents of the stomach of *R. tigerina* are tabulated below. The species appears to be polyphagous.

### DISCUSSION

Out of the 100 frogs dissected for their stomach contents 64 were females and 36 males. Frogs with their stomach contents weighed between 80 and 313 gm. with an average weight of 144 gm. It was ascertained that the frogs were locally collected from the Greater Bombay area.

It appears from the above data that land crabs, insects and juvenile frogs are the major food items. Land crabs are regarded as one of the major pests of paddy (Kadam *et al.* 1960) and are known at some stages of their life to feed on rice seedling both before and after transplanting. They also cause damage by forming holes in the embankments of fields.

| Material | Frequency of Occurrence/100 | Number of animals recovered in good condition | Species |
|---|---|---|---|
| **Invertebrates** | | | |
| i. Earthworm | 1 | Many | — |
| ii. Land slug | 4 | 14 | *Vaginula* sp. |
| iii. Snail | 4 | 6 | *Ariophanta* sp. and *Planorbis* sp. |
| iv. Land Crab (either complete or in parts) and a marine crab | 32 | 5 complete and many parts especially the chelae | *Paratelphusa mc-Canni* and *Gecarcinucus jacquemontii* |
| v. Prawn | 2 | exoskeleton | — |
| INSECTS | | | |
| vi. Beetle | 11 | 3 entire of elytra only | *Oryctes rhinoceros*, Cerambicid beetle, *Cybister* sp. (water beetle) |
| Orthopterous insects | 6 | 6 entire and many parts | *Periplanata americana*, *Grylotalpa* sp. Cricket (Gryllidae) |
| Plant bug | 2 | 26 | — |
| Caterpillar | 2 | 2 | — |
| Rat-tailed maggot | 31 | 17 | Larva of *Eristalis tenax* |
| Beetle larvae | 1 | 1 | — |
| OTHER ARTHROPODA | | | |
| Centipede | 3 | 3 | *Scolopendra* sp. |
| Spider | 1 | 1 | — |
| **Vertebrates** | | | |
| vii. Fish | 2 | 2 heads and dorsal spine | — |
| viii. Frog | 10 | 11 mostly in the form of loose skeleton | — |
| ix. Tortoise | 1 | 1 skull | — |
| x. Lizard | 1 | 1 | *Calotes versicolor* |
| xi. Snake | 1 | 3 | *Natrix stolatus* |
| xii. Shrew | 1 | 1 with skin | *Suncus murinus* |
| xiii. Rat | 1 | 1 young with skin | — |
| **Plant** | 23 | leaves, grass blades petioles etc. | — |

Crabs are taken by adult bull-frogs in the months of July-August. Wadekar (1963) has no record of crabs as food of *R. tigerina*.

The general diet consists of a variety of insects and their larvae. In one instance a frog had taken as many as 20 plant bugs.

A marine crab, prawns and marine fish heads recorded here are not natural food. Frogs may have eaten these when thrown out as kitchen refuse.

Seventeen out of 100 frogs had taken vertebrate animals. The three small snakes were possibly recently hatched young.

Vegetable matter in the form of leaves, grass blades, algae etc., were found in 23 frogs. Other material noted were rice husk, match sticks, charcoal pieces, marble, a legume and a spiny fruit, bidi-stubs, some animal faeces, and stones of various shapes and sizes. This material is taken while grabbing the food perhaps with jaws rather than by the use of the tongue. McCann (1933) states that anything not edible is at once ejected. This is not in conformity with the present observation. In cases where the material is undigestible and large enough to obstruct its passage through the pylorus, it may be vomitted out later by reverse peristalsis but no discrimination seems to be made by the frog between edible and non-edible during feeding.

This frog is in great demand from educational institutions within the country for studying it as a type animal, and its legs are exported. In 1961 about 35-40 tons of frog legs were exported from India (*Indian Trade Journal* 1962). In Kerala where processing of frog legs is done on a large scale, the earnings for 1960-1963 is given as Rs. 51.66 lakhs for 8.85 lakh Kg. frog-legs (Rukmini Devi 1964). The situation demands that the natural breeding be supplemented by rearing this frog in captivity.

Food of juvenile frogs consists largely of insects (Jameson & Rose 1956) and that of tadpoles mainly the different species of algae (McCann 1933, Kamat 1962). Knowledge of the specific food habits during tadpole, juvenile and adult stages of the bull frog may help as a primary step in frog breeding in captivity.

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# 21. NOTES ON ANIMAL RELATIONSHIPS : HYPERIID AMPHIPODS *PHRONIMA COLLETTI* BOVALLIUS AND *PHRONIMA SEDENTARIA* (FORSKÅL) INHABITING EMPTY 'TESTS' OF PELAGIC TUNICATES

During the 35th cruise of the USSR Research Vessel *Vityaz* in the eastern sector of the Indian Ocean in 1962 some interesting animal relationships of two species of phronimid amphipods, *Phronima colletti* Bovallius and *P. sedentaria* (Forskål) inhabiting the empty 'tests' of pelagic tunicates *Salpa* sp. and *Doliolum* sp. respectively were observed, which are reported here.

1. *Phronima colletti* Bovallius. 10 young forms measuring 1·5 mm. in total length attached to the wall of the empty test of *Salpa* sp. measuring 9 mm. in length, were collected at *Vityaz* Station no. 5224 on 10-ix-1962 (02° 00′ N., 91° 33′ E., depth 0-200 m.). These phronimids were attached in a single group and composed of individuals of the same instar. The characteristic shape of the carpus in the fifth peraeopod is distinctly discernible (*vide* Stephenson, 1924).

2. *Phronima sedentaria* (Forskål). An adult female measuring 30 mm. was obtained within the empty test of *Doliolum* sp. measuring

31 mm. collected at *Vityaz* Station no. 5185 on 27-vii-62 (24° 34′ S., 108° 20′ E., depth 0-200 m.).

In the literature there are records of adults and juveniles of *P. sedentaria* (Forskål) inhabiting the empty mantles of pelagic tunicates (Chevreux & Fage 1925, Mogk 1927, Barnard 1932, 1937, and Nagabhushanam 1960). However, there appears to be no record of the young forms of *P. colletti* Bovallius inhabiting the empty mantles of tunicates. Moreover, the duration of stay of the young instars and the size attained within the mantle-cavity by the species of the genus *Phronima* other than *P. sedentaria* (Forsk.), is not known. Therefore it is considered worthwhile recording, this interesting relationship, and the measurements of the adult and juveniles obtained. More information on the stages at which the juveniles desert the mantle in the different species of the genus *Phronima* would be worth recording.

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## 22. NOTE ON *MASTIGOCHIRUS QUADRILOBATUS* MIERS, AN ANOMURAN (CRUSTACEA : DECAPODA) NEW TO INDIA

*Mastigochirus quadrilobatus* Miers is an anomuran which has not been reported from India so far. During the course of our study on the systematics of the anomuran fauna of Waltair coast, 10 specimens of *M. quadrilobatus* were collected from Lawson's Bay area, Waltair. In this paper a short account of the diagnostic features of *M. quadrilobatus* is given.

### **Mastigochirus quadrilobatus** Miers 1879

*Diagnosis.* Frontal margin with two submedian lobes flanked by a lateral lobe which is round and projects slightly beyond the median

lobes. Lateral margin with submarginal series of short transverse setiferous pits. Antennules and antenna short, third maxilliped rather slender. First pair of legs very long and very slender with the last joint especially greatly elongated and multiarticulate.

*Measurement.* Carapace length : 12·5 mm.

*Distribution.* Philippines.

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## 23. FORMS OF *DANAUS CHRYSIPPUS* L.

I was interested to learn from J. P. Donahue's ' An Annotated List of the Butterflies of Delhi ' (1967, *J. Bombay nat. Hist. Soc.*, **64** : 40) that an example of f. *alcippoides* Moore had been caught there fairly recently and that he considered it only a matter of time before f. *dorippus* Klug turned up also. In my twenty-four years collecting in India—in the Punjab, the United Provinces and Bengal—I never saw an example of either form. I did, however, have the good fortune to rear an example of the far rarer f. *amplifascia* Talb. from a chance found larva in Calcutta. Talbot recorded only five known specimens of this form, not including mine, and, for those who are unacquainted with it, it can be described briefly as having the white spots of the pre-apical band extended inwards along the interspaces to the discocellular.

Although there are constant differences between the African, Asiatic and Australian races of *chrysippus* in the pre-apical markings of the forewing and in the extent of the white in the hindwing of ff. *alcippus* Cr. and *alcippoides* Moore, I consider that there are basically four forms, namely :

*chrysippus* L., with black and white pre-apical marking in the forewing and brown hindwing.

*dorippus* Klug, with no black and white pre-apical marking in the forewing and brown hindwing.

*alcippus* Cr., with black and white pre-apical marking in the forewing and white hindwing.

*albinus* Lanz., with no black and white pre-apical marking in the forewing and white hindwing,

and the varying proportions of these four forms in the various parts of the species' enormous range has always intrigued me.

In Asia *chrysippus* is the predominant form, with *dorippus* and *alcippoides* rare, although I believe *dorippus* is commoner at Aden. In Australia, I believe, only the *chrysippus*-like form occurs.

In Africa, *chrysippus* is the predominant, if not the only, form in the extreme north (Egypt) and south (South Africa). In Rhodesia, formerly Southern Rhodesia, both *dorippus* and *alcippus* occur rarely. In the inter-tropical zone there is a most interesting gradation. On the east coast *dorippus* is the predominant form, with *chrysippus* and *albinus* occurring rarely, I have never seen *alcippus*. Going inland and westward first *chrysippus* becomes more common in comparison with *dorippus* and then *alcippus* begins to appear. Going still further west, *dorippus* and *albinus* slowly fade out until in Uganda *chrysippus* and *alcippus* are the main forms. Then *chrysippus* decreases until on the West Coast *alcippus* is the prevalent, if not the only, form occurring.

As *chrysippus* is a protected species in all its forms, the varying proportions can hardly be due to differences in selective predation, and are, presumably, caused by reaction to climatic differences.

I have been unable to work out the local genetics with any degree of certainty due to the very heavy losses from parasitisation by a Tachinid that presumably lays its eggs in the tormentum on the underside of the leaf of the food-plant. The three imagines that emerged from a small number of ova laid by a *chrysippus* female were all *dorippus*, as was the sole imago from a brood from an *albinus* female. This would seem to indicate that *dorippus* is dominant to *chrysippus*, and probably to *albinus*, results in conformity with the proportions in nature. But if the brown hindwing gene is dominant to the white, why should *alcippus* be the prevalent form on the West Coast of Africa, and why should *dorippus* be so rare in Asia ?

I have since discovered that feeding larvae with *Calotropis* flowers and not with leaves prevents the Tachinid infestation.

MOMBASA. D. G. SEVASTOPULO
*November* 17, 1967.

## 24. STUDIES ON SOME PASSALIDS (COLEOPTERA) OF KERALA—I. BIOLOGY OF *PLEURARIUS BRACHYPHYLLUS* STOLICZKA[1]

(*With a plate*)

### Introduction

The Passalidae are a small family of rare beetles, of about 800 known species found in the tropical regions of America, Indo-Australia, and Ethiopia. Some species have attained a certain degree of social organisation, which is very rare among Coleoptera. The grubs and adults are capable of stridulation, a feature associated with its social habits. Many species are incapable of flight even though their wings are fully developed. Almost all passalids are lignicolous and are borers of felled timber.

Apart from some general information on passalids, no detailed study is available on the life history of any particular member of this interesting family. Hence investigations on the biology and bionomics of three species of passalids commonly found in the high ranges of Kerala, namely *Pleurarius brachyphyllus* Stol., *Basilianus indicus* Kuwert., and *Basilianus neelgherriensis* Perch., were undertaken. The present paper reports the data on *P. brachyphyllus*. These studies were conducted at Vattayar, a hill station in the Kottayam District of Kerala, situated at 3500 ft. above sea-level.

### Materials and Methods

Specimens were collected from felled logs or fallen timber which were suspected to contain the beetles. Infested wood could be detected by the presence on them of small entry holes plugged with faecal pellets and wood powder. For studying the life history, the eggs were reared in the laboratory in small metal containers. Wood powder premasticated by the adults was supplied, moistened, to the grubs as food. Such wood powder was collected from the galleries of the beetle in infested timber in the field. The containers were cleaned and fresh wood powder supplied frequently. The pupa was left undisturbed, especially during the early pupal period, to avoid injury. The rearing vessels were closed lightproof to simulate conditions in the field where the insect bred within dark galleries inside timber.

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[1] Part of thesis submitted to the University of Kerala, for the award of the M.Sc. degree.

## Biology

*Mating and Oviposition :* Mating lasts from 2 to 6 hours. The mating pairs were seen moving about, the female beetle carrying its partner on its back or dragging it behind. For oviposition the female goes to the deeper tunnels and lays a single egg at a time. In the laboratory the female burrows deep into the wood dust for laying eggs. The number of eggs laid by a female varies from 5 to 9, laid at intervals of 6 to 8 days. In the field the eggs were found buried in the wood powder on the floor of the tunnels. Maximum number of eggs were collected from the field during the rainy season (June to August).

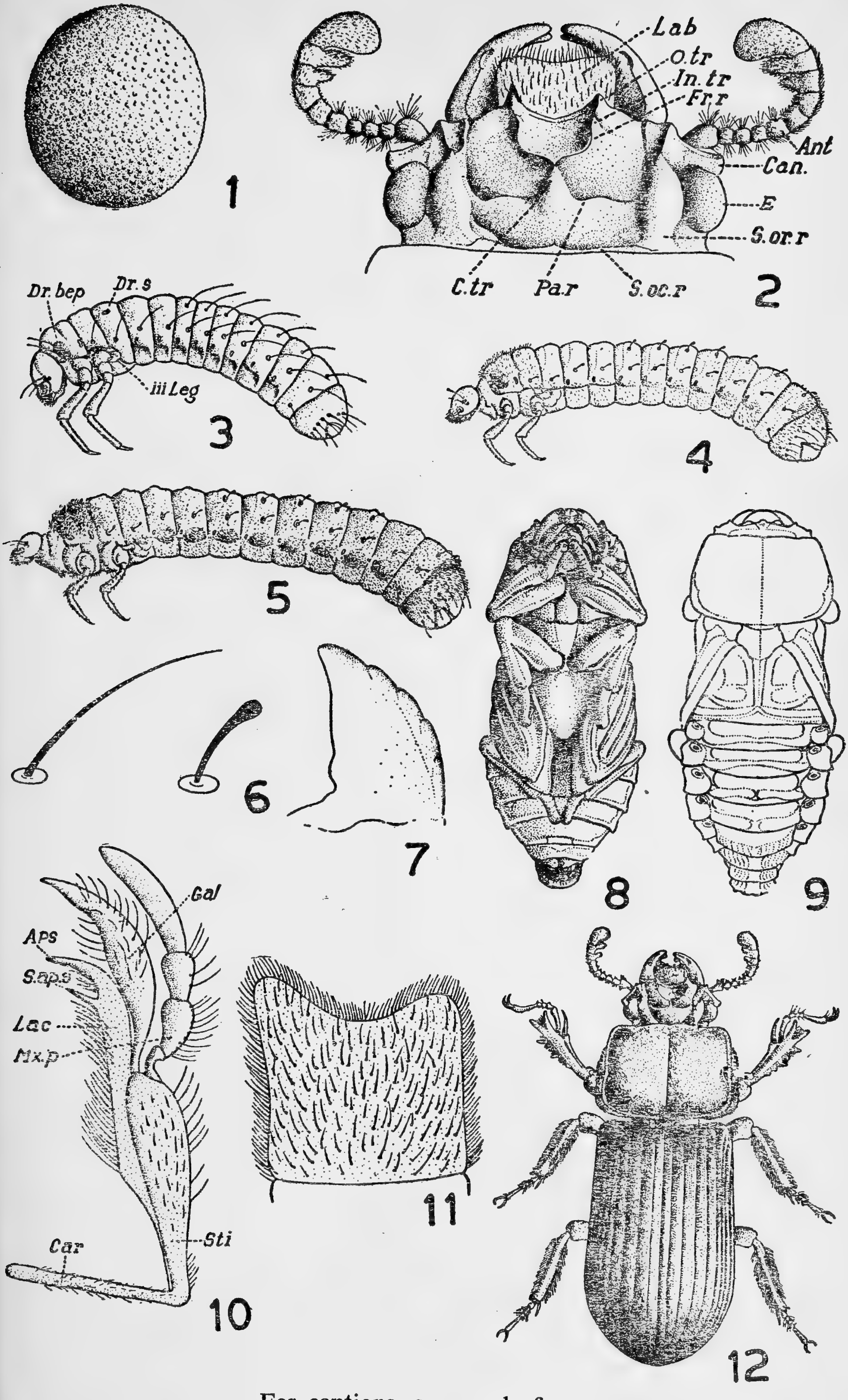
*Egg :* (Fig. 1) The egg is spherical or ovate and 4 mm. in diameter. The chorion is leathery, dark brown to black in colour and the surface honeycomb patterned. A high degree of moisture is necessary for the eggs to survive and develop. Eggs kept in dry wood dust shrivel up. Under laboratory conditions the egg requires 28 to 34 days for hatching. (*Vide* Table). At the time of hatching a U -shaped slit appears on the chorion and the grub forces its way out through this.

*Grub :* The newly hatched grub is 8 mm. long and is milky white. After a few hours it starts feeding on the wood powder produced by the adult. It does not feed on artificially made wood powder. The first instar grub attains a length of 29 mm. and a thoracic width of 4·6 mm. (Fig. 3). The arrangement and distribution of the long hairs on the body of passalid grubs are of taxonomic importance. In *P. brachyphyllus* there are, two long brown hairs behind each antennal base, three long hairs on the prothoracic depression, a pair of hairs on the meso and meta terga, a pair of lateral hairs on the first 2 abdominal segments, a pair of lateral and a pair of dorsal hairs on the third to ninth abdominal terga and 14 circum-anal hairs in a whorl on the tenth segment and a pair on the ninth sternum.

Two elongated, oval brown dorsal spots are present, on the meta tergum of the first instar grub. As in the case of other passalid grubs, here also the third pair of legs (Fig. 7) are stumpy, conical, and the border lined with 5 sub-marginal black teeth, which help in stridulation.

There are three larval instars. The duration of the first instar is nearly 50 to 60 days.

All the long hairs, except those behind the antennal base and circum-anal region, are clavate and short in the second and third instar grubs (Fig. 6). The meta tergal 'dorsal spots' are absent in these stages. The second instar grub (Fig. 4) attains a length of 35 to 37 mm. The durations of second and third instars are 54 to 65 days and 80 to 90 days respectively. The third instar grub (Fig. 5) measures 48 to 52 mm. long and 10 mm. broad across thorax. As it nears pupation the grub turns pale and becomes white at the time of pupation.




For captions, see overleaf.

## *P. brachyphyllus* Stol.

1. Egg × 6. ; 2. adult head × 6 ; 3. I instar grub × 1·5 ; 4. II instar grub × 1·5 ; 5. III instar grub × 1·2 ; 6. filifom and clavate hairs of II instar grub ; 7. Third leg of the grub × 20 ; 8. pupa ventral view × 1·5 ; 9. pupa dorsal view × 1·5 ; 10. Maxilla of the adult × 12 ; 11. labrum of adult × 12 ; 12. Adult beetle × 12.

*Abbreviations*

Ant : antenna. Ap.s. : apical spine. Can. Canthus. Car : Cardo. C. tr : Central tubercle. Dr. dep : dorsal depression. Dr. s : Dorsal spot. E : Eye. Fr. r : Frontal ridge. Gal : galea. In. tr : Inner tubercle. Lac : lacinia. Mx. p : Maxillary palp. O. tr : Outer tubercle. Pa. r: Parietal ridge. S. ap. s : Sub-apical spine. S.oc.r.; Sub-Occipital ridge. Sti : stipes.

TABLE

DURATION IN DAYS OF DIFFERENT STAGES OF
*P. brachyphyllus* REARED IN THE LABORATORY

| Sl. No. | Egg | I instar | II instar | III instar | Pupa |
|---|---|---|---|---|---|
| 1. | 32 | 51 | 65 | 82 | 28 |
| 2. | 30 | 50 | 62 | 86 | 26 |
| 3. | 28 | 61 | 54 | 91 | 31 |
| 4. | 29 | 47 | 58 | 81 | 32 |
| 5. | 32 | 50 | 56 | 83 | 27 |
| 6. | 34 | 54 | 61 | 94 | 29 |
| 7. | 31 | 60 | 59 | 81 | 30 |
| 8. | 33 | 55 | 58 | 79 | 32 |
| 9. | 30 | 56 | 59 | 94 | 27 |
| 10. | 32 | 59 | 57 | 88 | 25 |
| 11. | 28 | 55 | 60 | 82 | 28 |
| 12. | 29 | 35 | 62 | 85 | 30 |
| Average | 30·7 | 54·3 | 59·3 | 85·5 | 28·7 |

*Pupa :* (Figs. 8 & 9) Pupation takes place within a loose case of agglutinated wood powder. Pupa is 40 to 45 mm. long and 15 mm. broad across thorax. The general colour of the pupa is white at first, then straw white and later pinkish brown. The pupal period lasts 25 to 32 days.

*Adult :* (Fig. 12) The newly emerged beetle is soft and reddish brown with velvety yellow hairs. In about 40 days it becomes hard and deep black. Stoliczka (1873) and Gravely (1914) described the adult of *P. brachyphyllus.* Features not covered by them are given here.

Shiny black, hard, and with yellow velvety hairs on the plueral side and legs. Female measures 40 to 45 mm. long and 18 mm. broad. In the same colony males are 3 to 6 mm. smaller than females. An interesting feature of this beetle is the presence of slight cephalic asymmetry ; the left outer tubercle is slightly larger than the right (Fig. 2) the left antero-lateral corner of the labrum is longer than the right, (Fig. 11) and the left mandible slightly bigger than the right. Lacinia (Fig. 10) in *P. brachyphyllus* has one apical spine and one sub-apical spine ; in all other species examined only the apical spine is present.

In the forests of Kerala this beetle has been collected from almost all species of felled soft timber. It first bores a few inches transversely and then constructs long tunnels along the long axis of the timber. A fully colonised trunk shows the presence of a number of longitudinal tunnels inter-connected by transverse tunnels. The masticated wood powder produced while tunnelling serves as food for grubs. The beetles reared in the laboratory survived up to one year.

### Distribution

*P. brachyphyllus* is confined to India, having been previously recorded from Puduthottam, Anamalai, Nilgiris and Kerala forest area, between altitudes 1500 and 4500 ft. above sea-level.

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Thanks are due to Dr. C. C. John, former Vice-Chancellor of the University of Kerala, for guidance. Thanks are also due to Dr. M. R. G. K. Nair, Professor of Entomology, Agricultural College and Research Institute, Vellayani, Kerala for his interest in the work, and for the help rendered in the preparation of this paper.

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*October* 5, 1967.

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## 25. NOTES ON THE TAXONOMY AND OTHER ASPECTS OF CERTAIN SPECIES OF APHIDS IN INDIA

Current work on the taxonomy, biology and food plants of aphids in various parts of the world, has led to changes in the names of many of the species. In view of this, the names of some of the aphids have to be revised. Attention is here drawn to names that can be used for the Indian forms of these aphids. Notes are also added on the food plants and other aspects of these aphids.

1. **Therioaphis trifolii** (Monell) 1862.

*Pterocallidium maculatum* Buckton sec. David 1957-58 a.

The lucerne aphid has been studied intensively in recent years especially as a new introduction into north America. Hille Ris Lambers & van den Bosch (1964) reviewed the taxonomic studies of various workers.

They concluded that the length of the body hairs and antennae, the number of rhinaria on antennal segment III, the sclerotic pattern on the abdomen, and production of sexual forms are variable. Hence the aphid on lucerne called *Therioaphis trifolii* (Monell) or spotted alfalfa aphid, and the one on clover named *Pterocallidium maculatum* (Buckton) or yellow clover aphid, are the same and should be named *Therioaphis trifolii* (Monell).

This aphid occurs on lucerne, *Medicago sativa*, all over India except in the extreme south (Madras and Kerala). It evidently prefers colder regions or seasons for its normal life.

2. **Melanaphis donacis** (Passerini) 1882.

*Longiuniguis donacis* (Passerini) sec. David 1957-58b.

In a study of the generic characters of *Melanaphis* van der Goot and *Longiuniguis* van der Goot, Hille Ris Lambers (1966-67) states that the former produces wax when alive but is otherwise indistinguishable from the latter. Since this species produces wax on the body, it has to be in *Melanaphis* van der Goot.

In India this species is known only from the south where it lives on *Arundo donax* on the hills as well as the plains.

3. **Melanaphis (Longiuniguis) sacchari** (Zehntner) 1898.

*Longiuniguis sacchari* (Zehntner).

As mentioned for the previous species, Hille Ris Lambers states that *Longiuniguis* van der Goot can at best be considered a subgenus of *Melanaphis* van der Goot since this species does not produce wax. Hence the common sorghum and sugarcane aphid has to be called *Melanaphis* (*Longiuniguis*) *sacchari* (Zehntner).

4. **Melanaphis (Longiuniguis) indosacchari** (David) 1956b. New combination.

*Longiuniguis indosacchari* David.

This is a dark brown aphid which feeds on sugarcane leaves. It has been found to be widespread in south India.

5. **Schizaphis rotundiventris** (Signoret) 1867.

*Toxoptera cyperi* van der Goot 1917, new synonymy.
*Toxoptera piricola* Matsumura 1917.
*Toxoptera punjabipyri* Das 1918.

Since Das (1918) described *Toxoptera punjabipyri* on *Pyrus* sp., this aphid has not so far been met with on this plant in India. In Japan, however, this species is commonly known and the Indian name has been considered a synonym of *piricola* Matsumura (Tao 1963). An allied form, *Toxoptera cyperi* van der Goot, has been found to be widespread in India. It is now known that this aphid has *Pyrus* sp. as its primary host

and *Carex* sp. or *Cyperus* sp. as secondary hosts. Eastop (1966) mentions that this species has forms with long or short femoral hairs and that *rotundiventris* Signoret may be the oldest name in the complex. Hille Ris Lambers, in private correspondence, informed the author, that in spite of small differences, the aphid on *Pyrus* sp. and Cyperaceae may be the same. If this view is accepted, *cyperi* van der Goot, *piricola* Matsumura, and *punjabipyri* Das will become synonyms of *rotundiventris* Signoret.

Das (1918) recorded this aphid on *Pyrus* sp. in the Punjab and on *Cyperus* sp. from Punjab to Bengal. David (1957-58a) noted it on *Cyperus rotundus* in south India. The present record is on *Pyrus communis* (pear) in Amritsar, the Punjab (coll. O. S. Bindra, 6.III.67).

6. **Macrosiphoniella pseudoartemisiae** Shinji 1933.

Many species of *Macrosiphoniella* del Guercio occur commonly on species of *Artemisia* all over India. In recent collections this aphid was noted in Kashmir (Verma 1965). Present records are from Dehra Dun (22.IX.66, coll. S. K. David) in the central regions of Himalayas, and Kalimpong (12.X.66, coll. K. Narayanan) in the eastern Himalayas.

The important characters of this species are that the tibiae are pale in the middle, no scleroites at the base of dorsal hairs, antennal hairs short, about $\frac{3}{4}$ the basal breadth of antennal segment III, which segment in apterae have about 10 rhinaria in a line, and the last rostral segment is about $\frac{2}{3}$ of the second joint of the hind tarsus.

7. **Macrosiphoniella yomogifoliae** Shinji 1922.

This is another species of *Macrosiphoniella* del Guercio occurring in India on *Artemisia*. There appears to be no previous record of this species in India since the one recorded under this name in south India (David 1957-58b) has since been discovered to be another species. This species is now recorded in Dehra Dun (23.IX.66, coll. S. K. David) on *Artemisia vulgaris*.

The important characters of this species are that the tibiae are completely black, there are no scleroites at the base of dorsal hairs, antennal segment III is wholly black, hairs on it about equal to the breadth of the segment, the apterae have about 10 rhinaria on it in a jumbled fashion, and the last rostral segment is about $1\frac{1}{3}$ the second joint of the hind tarsus.

8. **Dactynotus (Uromelan) minutus** (ven der Goot) 1918.

*Dactynotus* (*Uromelan*) *dravidiana* David 1956b, new synonymy.

*Dactynotus* (*Uromelan*) *dravidiana* David was described from specimens collected on *Vernonia cineria* in Coimbatore in south India. *Macrosiphum minutus* van der Goot was described from Ceylon on *Vernonia* sp. Dr. D. Hille Ris Lambers has informed the senior author that since

the description of the latter agreed with the former and as the food plant is *Vernonia* in both, he and Dr. V. F. Eastop were of the opinion that it may be a synonym of the latter. Hence the south Indian species should be named *Dactynotus* (*Uromelan*) *minutus* (van der Goot). So far this species is known only from south India and Ceylon.

9. **Myzus ornatus** Laing 1932.

This is an aphid which has attained some importance since it is able to transmit several virus diseases of plants. Though Börner (1952) and Heinze (1961) synonymised it with *portulaccae* Macchiati, their conclusion has not been accepted by other workers.

This aphid was recorded in the Nilgiris in south India (David 1956a) and in western Himalayas (David 1958a). Present records are from *Salvia* in Kodaikanal in south India (24.XII.66, coll. S. G. Rajasingh), on grass in Simla in the central region of Himalayas (27.III.67, coll. K. Narayanan) and on a weed in Srinagar in Kashmir in the north-western Himalayas (22.III.67, coll. K. Narayanan).

10. **Myzus (Nectarosiphon) persicae** (Sulzer) 1776.

This is a well known aphid from its ability to transmit many virus diseases of various plants. The alate forms of this aphid have a characteristic dark path on the dorsum of the abdomen. In a recent collection of this species taken on potato in the Nilgiris, all the three alate forms lacked this sclerotic patch. Dr. D. Hille Ris Lambers, in private correspondence, informed the senior author that this condition occurs occasionally and is suspected to be due to an early infection of an entomogenous fungus.

11. **Micromyzodium filicium** David 1958b.

There has been no mention of this species since it was first described. It appears to be endemic to Nilgiris in south India where it lives on a large number of plants in conservatories. Present collections include the following additional food plants in Ootacamund. *Adiantum tinctum*, *Lastrea* sp., *Pityrogramme peruviana*, *Pteris critica* and *Streptocarpus* sp. It occurs all through the year.

12. **Phorodon (Diphorodon) cannabis** Passerini 1860.

*Phorodon cannabis* Passerini.

Das (1918) pointed out that this species differs from other species of *Phorodon* Passerini in the presence of capitate hairs on the head, antennae and dorsum, the corrugated pattern on the abdominal tergites and slightly swollen cornicles. Börner (1939) separated this species under the subgenus *Diphorodon*.

This aphid is known in India from the north-west region on *Bhang*, *Cannabis sativa*, on which it is monophagous. The present record is from Bhunga, the Punjab (20.xi.65, coll. D. R. C. Bakheita).

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MADRAS CHRISTIAN COLLEGE,
MADRAS.
*June* 20, 1967.

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## 26. ON A NEW FLAGELLATE, *TRICHOMITUS HYDERABADENSIS* SP.NOV. FROM THE FROG, *RANA TIGERINA* (DAUD.)

(*With five text-figures*)

Numerous interesting flagellates were collected during a survey of the intestinal flagellates of amphibians of the Hyderabad region, carried out by the author during the period 1960-63. One of these, belonging to the genus *Trichomitus* Swezy, 1915 (Order Trichomonadida, Kirby, 1947 ; Family Trichomonadidae Chalmers & Pekkola, 1918 emend. Honigberg, 1963 ; Subfamily Trichomonadinae Chalmers & Pekkola, 1918 emend. Honigberg 1963) is described in this communication.

The slides used in the study were stained with Heidenhain's Iron Haematoxylin after fixation in Schaudinn's fluid or with Giemsa's stain after fixation in methanol. The drawings were made with a camera lucida, at a magnification of about $\times$ 2000.

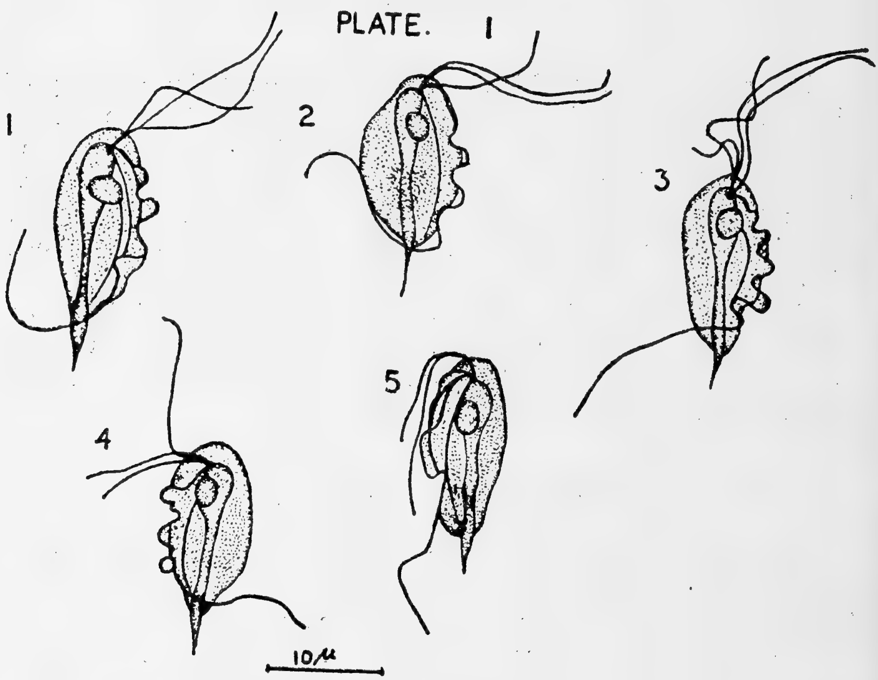
### **Trichomitus hyderabadensis** sp. nov.

The parasite is fusiform in shape, having a broad and rounded anterior end and a somewhat narrower tapering posterior end (Figs. 1, 4, 5). The maximum breadth of the body is attained near the junction of the anterior and mid-third of the body (Figs. 2, 5).

The blepharoplast is a large and conspicuous granule situated about 1-2 $\mu$ behind the anterior extremity. It gives origin to the mastigont elements comprising of three anterior flagella, a posterior flagellum, two accessory filaments, a costa and an axostyle (Figs. 1, 5).

The three anterior flagella are of the same diameter but are unequal in length, the longest measuring a little more than the body length (Figs. 1, 2, 4, 5). While a majority of the parasites examined had only three anterior flagella, there were a few organisms in which there was a fourth anterior flagellum which was much shorter than the others (Fig. 3). The posterior flagellum, running along the outer border of the undulating membrane and becoming free posteriorly, has a long trailing portion reaching up to about one-and-a-half times the length of the body (Figs. 1-3). In addition to the posterior flagellum, the undulating membrane is bordered by an accessory filament, which is of the same thickness as the flagellum (Figs. 1, 5) and runs up to the posterior end of the mem-

brane. Besides, there is an additional filament running between the costa and the accessory filament (Figs. 1, 5). This secondary filament is slightly thinner and shorter than the accessory filament. The undulating membrane extends almost up to the posterior end of the body and is thrown into four to seven folds. The folds show a gradual transition from the anterior to the posterior end, being short and shallow to begin with but large and deep posteriorly (Figs. 1, 3).




*Trichomitus hyderabadensis* sp. nov.

The costa is slightly thicker than the flagellum and runs a somewhat curved course, extending up to the posterior end of the undulating membrane (Figs. 2, 5). It is almost equidistant from the axostyle as well as the undulating membrane.

The axostyle is well developed and has its anterior portion expanded to form a spoon-shaped capitulum (Figs. 1, 2, 3), while the remaining portion is uniform in diameter throughout its course inside the body (Figs. 4, 5). At the posterior end it emerges out of the body and tapers to a pointed tip (Figs. 2, 3). The axostylar spike shows a range of 2·06-7·20 $\mu$ in length, with an average of 4·55 $\mu$. The axostyle does not possess either a swelling or periaxostylar chromatic granules at the point of its emergence from the posterior end of the body.

The nucleus, situated lateral to the spoon-shaped capitulum, is large and ovoidal and has a central endosome.

Neither a pelta nor a cytostome could be observed in the organism.

The dimensions of the parasite are shown in Table 1.

TABLE 1

DIMENSIONS OF *Trichomitus hyderabadensis*

| Particulars | Minimum | Maximum | Average |
|---|---|---|---|
| | (in microns) | | |
| Length of body (excluding spike) .. | 12·85 | 22·11 | 16·45 |
| Maximum width of body .. | 5·14 | 13·88 | 8·56 |
| Length of anterior flagellum I .. | 9·25 | 20·05 | 15·09 |
| Length of anterior flagellum II .. | 13·37 | 22·11 | 18·46 |
| Length of anterior flagellum III .. | 16·97 | 26·73 | 20·81 |
| Length of free posterior flagellum .. | 12·34 | 25·19 | 17·54 |
| Size of nucleus .. | 2·06 × 1·54 | 4·11 × 3·60 | 3·13 × 2·44 |

## DISCUSSION

Flagellates of this genus have been recorded from many amphibia by several workers. Honigberg (1953) gives a comprehensive account of the structure, synonymy and host-list of the common form, *Trichomitus batrachorum* (Perty). The present parasite is distinguished from that species by the absence of the pelta, by the fusiform as contrasted with the ovoidal shape and by its fairly large size. According to Honigberg (1953), the strain of *T. batrachorum* from *Rana* measures 8·5 - 14·5 × 4·5 - 13·0$\mu$ (average 11·5 × 7·5$\mu$) and the strain from *Bufo* measures 8·5 - 21·0 × 4·5 - 20·0$\mu$ (average 12·5 × 9·0$\mu$). As against this, the present organism measures 12·85 - 22·11$\mu$ × 5·14 - 13·88$\mu$ (average 16·45 × 8·56$\mu$).

Among other species of the genus, *T. ulmeri* Gabel (1954b) comes nearest to the present form in not having a pelta, a cytostome or paracostal granules, but is much smaller in size and has an extremely long trailing flagellum, about two-and-a-half times the length of the body. In the absence of the pelta, the new organism also resembles *T. rotunda* Hibler *et al.* (1960), but differs in its larger size and in the presence of unequal anterior flagella.

A comparison of the body dimensions of the new species with other species reported so far (Table 2) shows it to be distinctly larger than any of them.

The type specimens are deposited in the Protozoology Section of the Zoology Museum, Marathwada University, Aurangabad,

TABLE 2

COMPARATIVE DIMENSIONS OF THE VARIOUS SPECIES OF THE GENUS *Trichomitus*

| Species | | Length | Breadth |
|---|---|---|---|
| *T. batrachorum* (Perty) Honigberg, 1953 | .. | 8·50-14·50 μ (11·50) | 4·50-13·00 μ (7·50) |
| *T. wenyoni* Wenrich & Nie, 1949 | .. | 4·00-8·80 μ (5·80) | 3·00-5·50 μ (3·64) |
| *T. marmotae* (Crouch) Gabel, 1954 | .. | 5·20-10·50 μ (7·53) | 3·30-7·10 μ (5·11) |
| *T. ulmeri* Gabel, 1954 | .. | 4·00-9·00 μ (5·78) | 1·00-4·00 μ (3·18) |
| *T. rotunda* Hibler *et al.* 1960 | .. | 6·83-11·40 μ | 4·56-7·41 μ |
| *T. hyderabadensis* sp. nov. | .. | 12·85-22·11 μ (16·45) | 5·14-13·88 μ (8·56) |

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*September* 6, 1967.

R. KRISHNAMURTHY

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*D. orbiculata* Hook. f. ♂ plant. a. Habit. b. Dendroid & stellate hairs (highly enlarged). c. Fl. bud. d. Sepal. e. Petal. f. Stamen. Inset map at top indicates the present distribution.

## 27. A NOTE ON THE OCCURRENCE OF *DIOSCOREA ORBICULATA* HOOK. F. IN INDIA

(*With a plate*)

A rare *Dioscorea* collected from Palin in Subansiri District was found to be *D. orbiculata* Hook. f., as per literature references cited here.

*D. orbiculata* Hook. f., is so far known to occur only in Sumatra (Asahan), Malay Peninsula (Puket to Johore) and Perak (see inset map). The present discovery of this species in Subansiri, offers a new distributional locality outside the Malaysian region, suggesting the phytogeographic affinities of these areas. Even though the intervening area gives a discontinuous distribution for this species, it is likely that further exploration will bring out the presence of this species in these areas.

Incidentally, it may be noted that *Deka* 16932 from Jeypore in Lakhimpur Dist., Assam, with distinctly stellate-dendroid pubescent flower buds with oblong anthers, appears more likely to be this species rather than *D. pyrifolia* Kunth var. *ferruginea* Prain et Burk. (Panigrahi & Naik *Bull. Bot. Surv. India* 8 (1) : 89, t. 1, 1966).

**Dioscorea orbiculata** Hook. f. Fl. Brit. Ind. 6 : 292, 1892 ; Prain & Burk. in Ann. R. Bot. Gard. Calc. 14 : 411, t. 145, 1938 ; Burk. in Fl. Mal. 4 : 334, 1951.

*Stems*, wiry, twining to the right, brown tomentose when young, becoming glabrescent except at nodes ; tomentum stellato-dendroid hairy. *Leaves* opposite or alternate, orbicular-ovate to ovate-cordate, acuminate, *c.* 13·5×8·5 cm., 7-nerved, glabrous above, deciduously floccose tomentose except in the nerve axils beneath ; petiole up to 9 cm. long, pulvinate, densely hairy. *Male Fl. spikes* whorled on long leafless inflorescences or in leaf axils, up to 4 cm. long, 20-25-flowered, densely dendroid hairy. *Fl. buds* globose, *c.* 2 mm. in diameter, stellate and *dendroid* hairy ; *bracts* ovate-acuminate, *c.* 1 mm. long, stellate hairy, base auriculate partly girdling the axis ; *sepals* 3, broadly ovate, cupular, *c.* 1·5 mm., brown stellate hairy outside, apex obtuse, *petals* 3, oblong-ovate, *c.* 1 mm. long, apex bluntly acute ; *stamens* 6, filaments 0·5 mm., anthers 1 mm., oblong ; *pistillode* short, conical.

On humid densely forested hill slope of the Khru River, *c.* 1400 m. alt., near Palin. Rare.

INDIA : N.E.F.A. : *Subansiri Dist.* : Palin vicinity, 15-5-1966, *A. R. K. Sastry* 45292, fl. (ASSAM).

My sincere thanks are due to Dr. A. S. Rao, Regional Botanist, Botanical Survey of India, Eastern Circle, Shillong, for critical suggestions.

BOTANICAL SURVEY OF INDIA,
EASTERN CIRCLE,
SHILLONG.
A. R. K. SASTRY
*November* 15, 1967.

## 28. SOME INFRASPECIFIC TAXA OF THE *PANICUM COLORATUM* L. COMPLEX

*Panicum coloratum* L. is a complex taxon comprising several distinct forms having chromosome numbers $2n=18$, 36, 32 and 54 (Joshi, Patil & Manchanda 1959 ; Patil, Vohra & Joshi 1961), which are poorly understood taxonomically and phylogenetically. The author (Jauhar 1963) studied 8 tetraploid ($2n=36$) and two hexaploid ($2n=54$) forms of this grass in considerable detail from the standpoints of morphology (both vegetative and floral), foliar epidermal patterns, chromosome behaviour during meiosis and pollen characters with a view to utilize this information for assessing precisely their taxonomic status and understanding evolutionary trends in them. From these studies it was convincingly shown that *P. coloratum* constitutes a heterogeneous assemblage, the range of variation present in it transgressing specific limits. In view of this, the 10 types of *P. coloratum* were classified into six distinct groups which are remarkably uniform within themselves and strikingly different from one another. The hexaploid group was elevated to a specific rank and named as *Panicum nehruense* Jauhar *et* Joshi (Jauhar & Joshi 1966).

From among the tetraploid types one was named as *Panicum simpliciflorum* Jauhar *et* Joshi (Jauhar & Joshi 1965) primarily on the basis of its typically simple, raceme-type panicle because it lacks some of the key characters of *Panicum coloratum* (see Jauhar 1967). The remaining four groups with $2n=36$ chromosomes have been retained under *P. coloratum* and given infraspecific ranks ; they have been designated as varieties.

Some salient diagnostic features of the four varieties are described below :

### **P. coloratum** var. **subglabrum** Jauhar var. nov.

Gramen perenne, moderate altum, caespitosum, erectum, tetraploideum ($2n=4x=36$), rarius superne ramosum. *Culmi* 104-120 cm. alti, 5-8-nodi ; nodi et partes inferiores internodorum paulum pilosi et debiliter tincti pigmento brunneo. *Folia* et foliorum vaginae sparse

pubescentes ; folium secundum 18-30 cm. longum, 0·5-0·8 cm. latum. *Ligula* fimbriata, ciliolata, ad 1 mm. longa. Panicula effusa et bene ramosa, 15-23 cm. longa, 12-16 cm. lata. Spiculae acutae, flaccidae, ad glumas tinctae colore pallide purpureo, 3·0-3·3 mm. longae. *Gluma inferior* ad. 1·5 mm. longa, 1-nervia, rarius nervis 1-2 inconspicuis additivis praesentibus. Nervi in glumis et in inferiore lemmata (i.e. in flore staminato) alte conspicui. *Lemma superius* nitens, semi-coriaceum.

Oriundus ex Australia, typus, *P.P. Jauhar 1*, positus in herbario sectionis botanicae in Instituto Indico Agriculturae ad New Delhi ; isotypi ponendi in herbario ad Dehra Dun, et ad Calcuttam.

**Panicum coloratum** L. var. **subglabrum** Jauhar, var. nov.

Medium tall, moderately caespitose, erect-growing, tetraploid ($2n=4x=36$), perennial grass rarely branched above. *Culms* 104-120 cm. tall, 5-8 noded. Nodes and lower parts of internodes slightly hairy and feebly tinged with light brown pigment. *Leaves* and leaf-sheaths sparsely pubescent ; second leaf 18-30 cm. long and 0·5-0·8 cm. broad. *Ligule* fimbriate, ciliolate, up to 1 mm. long.

*Panicle* effuse and well-branched 15-23 cm. long and 12-16 cm. broad. *Spikelets* acute, flaccid, suffused with light purple pigment at the glumes, 3·0-3·3 mm. long. *Lower glume* up to 1·5 mm. long, 1-nerved, rarely 1 or 2 additional, faint nerves also present. Nerves on the glumes and lower lemma (lemma of the staminate floret) highly conspicuous. *Upper lemma*, glossy, semi-coriaceous.

The type was originally obtained from Australia. Type. *P. P. Jauhar* 1, deposited in Herbarium Botany Division, Indian Agricultural Research Institute, New Delhi ; isotypes, to be deposited in Herbaria at Dehra Dun and at Calcutta.

**Panicum coloratum** var. **subcompositum** Jauhar var. nov.

Gramen perenne, nanum, foliosum, molle, tetraploideum ($2n=4x=36$) habitu erecto patenti, rarius ramoso supra. *Culmi* 90-105 cm. longinodis 5-8 ornati ; spatia internodalia glabra, sulcata. *Folia* brevia, lineari-lanceolata, fere acuminata, glabrescentia, pilis nonnullis interdum ramosis ad marginem in parte basali laminae ; margines repandi, nervi medii vix conspicui ; folium secundum 14-20 cm. longum, 7-12 mm. latum. Vaginae foliorum puberulae vel sparse hirsutulae. *Panicula* brevis, compacta vel semicompacta, 12-17 cm. longa, et 8-10 cm. lata. *Spiculae* propinquae, 2·8-3·2 mm. longae, acutae ; *gluma inferior* ad 1·3 mm. longa, univervia, apiculata, marginibus apicalibus serratis ; *gluma superior* et *lemma inferius* (i.e. in flore staminato) 6-8 nervia, marginibus

apicalibus conspicue serratis. *Palea inferior* (i.e. in flore staminato) binervia, cuspidata, marginibus conspicue serratis. *Lemma superius* semi-coriaceum, interdum inconspicue nervosum.

Typus, *P.P. Jauhar 3,* primo ex Jodhpur obtentus, positus in herbario sectionis botanicae Instituti Invest. Agric. ad New Delhi ; isotypi deponendus in Herb. ad Dehra Dun et ad Calcutta.

**Panicum coloratum** L. var. **subcompositum** Jauhar var. nov.

A dwarf, leafy, tender, tetraploid ($2n=4x=36$), perennial grass with erect open growth habit, rarely branched above. *Culms* 90-105·0 cm. tall, terete, 5-8-noded ; internodes glabrous, sulcate. *Leaves* short, linear-lanceolate, almost acuminately pointed, glabrescent, a few branched hairs scattered on the basal portion of the lamina margin ; leaf-margins repand ; mid-rib less conspicuous ; second leaf 14-20 cm. long and 7-12 mm. broad. Leaf-sheaths puberulous or sparsely hirsutulose.

*Panicle* short, compact to semi-compact, 12-17 cm. long and 8-10 mm. broad. *Spikelets* closely spaced, 2·8-3·2 mm. long, acute. *Lower glume* up to 1·3 mm. long, 1-nerved, apiculate, apical margins serrated. *Upper glume* and *lower lemma* (lemma of the staminate floret 6-8 nerved), apical margins and tip conspicuously serrated. *Lower palea* (palea of the staminate floret) 2-nerved, cuspidate, margins conspicuously serrated. *Upper lemma* semi-coriaceous, sometimes inconspicuously nerved.

The type was originally obtained from Jodhpur. Type, *P. P. Jauhar 3*, deposited in Herbarium Botany Division, Indian Agricultural Research Institute, New Delhi ; isotypes to be desposited in Herbaria at Dehra Dun and at Calcutta.

**Panicum coloratum** var. **glaucum** Jauhar var. nov.

Gramen perenne, procerum, glaucum, robustum, macrophyllum, tetraploideum ($2n=4x=36$), habitu erecto-patenti. *Culmi* 120-140 cm. longi, nodis 6-9, rarius ramosi supra. Nodi eminentes et glabri. *Folia* coriacea, glabra, glauca nervo medio valide conspicuo ; folium secundum 23-35 cm. longum, 7-11 mm. latum. *Ligula* 1·4-1·6 mm. longa, ciliolata.

*Panicula* 22-32 cm. longa, 16-21 cm. lata, alte effusa et ramosa. *Spiculae* 3·3-3·6 mm. longae, subacutae vel acutae, venetae colore. *Gluma inferior* ad 1·6 mm. longa, nervo uno conspicuo ; nervis in glumis et inferiore lemmate conspicuis ; *gluma superior et lemma inferius* 8-11-nervia, fere cuspidata ; *lemma superius* coriaceum, leve, nitens. *Stigmata* alte plumosa, colore alte chermesino. *Antherae* aurantiacae.

Typus, *P. P. Jauhar 4*, initio ex Jodhpur obtentus, positus in herbario sectionis botanicae Instituti Investigationis Agricolae ad New Delhi; isotypi deponentur in herbario ad Dehra Dun et ad Calcutta.

**Panicum coloratum** L. var. **glaucum** Jauhar var. nov.

A procerus, glaucous, robust, macrophylous, tetraploid ($2n=4x=36$) perennial with erect, open, growth habit. *Culms* 120-140 cm. tall, 6-9 noded, rarely branched above. Nodes prominent and glabrous. *Leaves* coriaceous, glaucous, glabrous, mid-rib very conspicuous; second leaf 23-35 cm. long and 7-11 mm. broad. *Ligule* 1·4-1·6 mm. long, ciliolate.

*Panicle* 22-32 cm. long, 16-21 cm. broad, highly effuse and branched. *Spikelets* 3·3-3·6 mm. long, sub-acute to acute, sea-green in colour. *Lower glume* up to 1·6 mm. long with one conspicuous nerve. Nerves on the glumes and lower lemma conspicuous. *Upper glume*, as the *lower lemma*, 8-11 nerved, almost cuspidate. *Upper lemma* coriaceous, smooth and glossy. *Stigmas* highly plumose, deep carmine in colour. *Anthers* orange-chrome in colour.

The type was originally obtained from Jodhpur. Type, *P. P. Jauhar 4*, deposited in Herbarium Botany Division, Indian Agricultural Research Institute, New Delhi; isotypes to be deposited in Herbaria at Dehra Dun and at Calcutta.

**Panicum coloratum** var. **glabrum** Jauhar var. nov.

Gramen perenne, gracile, alte caespitosum, glabrum, dense fasciculatum, tetraploideum ($2n=4x=36$). *Culmi* 80-100 cm. alti, 6-13 nodi. *Folia* angusta, glabra, acuminata; nervo medio inconspicuo; folium secundum 12-18 cm. longum, 0·3-0·6 cm. latum; foliorum vaginae glabrae. *Ligula* 1·2-1·4 mm. longa, fimbriata. *Panicula* semieffusa, 11-19 cm. longa, 10-14 cm. lata. *Spiculae* 2·6-3·0 mm. longae, acuminatae, flaccidae. Glumae et lemma inferius fortiter nervosa, apicibus minutim serrulatis. *Lemma inferius* multo longius palea inferiore. *Lemma superius* leve, nitens, semicoriaceum. *Stigmata* plumosa, 'Aster'-purpurea.

Typus, oriundus e page Toddapur prope Delhi et probabiliter ex Australia in Indiam ad latus anno 1958, positus in sectione botanica Instituti Indici Agriculturae ad New Delhi sub numero *P. P. Jauhar 7*.

**Panicum coloratum** L. var. **glabrum** Jauhar var. nov.

A slender, highly caespitose, glabrous, densely tufted, tetraploid ($2n=4x=36$), perennial. *Culms* 80-100 m. tall, 6-13 noded. *Leaves*

narrow, glabrous, acuminately pointed ; mid-rib inconspicuous ; second leaf 12-18 cm. long and 0·3-0·6 cm. broad. Leaf-sheaths glabrous. *Ligule* 1·2-1·4 mm. long, fimbriate.

*Panicle* semi-effuse, 11-19 cm. long and 10-14 cm. broad. *Spikelets* 2·6-3·0 mm. long, acuminate, flaccid. *Glumes* and *lower lemma* strongly nerved, with minutely serrulated apices. Lower lemma much longer than the lower palea. *Upper lemma* smooth, glossy, semi-coriaceous. *Stigma* plumose, aster-purple.

The type was originally collected from Todapur Village (Delhi) and probably belongs to the collections obtained from Australia in 1958. Type, *P. P. Jauhar* 7, deposited in Herbarium Botany Division, Indian Agricultural Research Institute, New Delhi.


### Acknowledgements

The author expresses his sincere gratitude to Dr. A. B. Joshi and Dr. M. S. Swaminathan, for their valuable advice during the course of this study. His grateful thanks are also due to Prof. H. Santapau for his valuable suggestions regarding the nomenclature of the taxa studied and for rendering the diagnoses into Latin.



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*November* 18, 1967.

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## 29. ADDITIONS TO THE FLORA OF PAVAGADH HILL, GUJARAT STATE

The flora of Pavagadh by Chavan & Oza (1965) lists 500 angiosperms as occurring either at the foot of the hill or on the hill itself. Subsequently Shah & Inamdar (1965) published a fresh list of 26 plants, either not reported earlier or with new observations. Chavan, Bedi & Sabnis (1966) recorded a few more plants.

All these additional lists were of plants occurring near to the tracks leading to the top of the hill. The fact that even short trips of one or two days duration could add so many plants not reported in the flora of Pavagadh, prompted the authors to undertake a programme of exploration of the more inaccessible parts of the hill. The authors during their recent trip collected the following plants, which are not reported by earlier workers.

### Tiliaceae

1. **Triumfetta pilosa** Roth.

Not common ; noted near Machi and on way to Bhadra Kali temple. Flowers yellow. (BEDI 4506, 4507).

### Mimosaceae

2. **Mimosa pudica** Linn.

A Few specimens noted on the slopes near Machi Holiday Camp. (BEDI 4516).

### Compositae

3. **Glossocardia linearifolia** Cass.

Often seen growing in open grassy places near Bhadra Kali temple and steep rocky slopes near it. Plants are much stunted. (BEDI 4464).

### Asclepiadaceae

4. **Ceropegia candelabrum** Linn.

A twining perennial herb, with lemon-sized tubers. Flowers in lateral, umbellate cymes. Not common ; seems to be restricted in distribution. Collected from a very steep rocky slope near Machi ; often noted twining round *Euphorbia neriifolia* which are the common plants on the steep slopes (BEDI 4546).

### Gentianaceae

5. **Canscora concanensis** C. B. Clarke

A small (5-10 cm.) annual, erect herb. Calyx strongly four-winged. Not common ; noted on open grassy places on Machi plateau and near an old palace on way to Bhadra Kali temple. (BEDI 4536, 4537).

CONVOLVULACEAE

6. **Ipomoea pes-caprae** (Linn.) Sweet

It appears that this species has been recently introduced and is growing very well near Holiday Camp Canteen, producing flowers and fruits. (BEDI 4481).

MARTYNIACEAE

7. **Martynia annua** Linn.

A Mexican plant becoming naturalised at various places. Fairly common near the foot of Pavagadh hill, especially near the S.T. bus stop. (BEDI 4436)

8. **Securinega virosa** (Roxb. ex Wills.) Pax & Hoffm.

A large unarmed shrub. Often noted growing on steep hill slopes (BEDI 4642)

ARISTOLOCHIACEAE

9. **Aristolochia indica** Linn.

Restricted in distribution ; twining on *Carissa congesta,* by the side of fort walls near Machi. (BEDI 4567, 4568).

DIOSCOREACEAE

10. **Dioscorea daemona** Roxb.

Not common ; seen near the origin of river Vishwamitri. (BEDI 4476, 4477).

HYPOXYDACEAE

11. **Curculigo orchioides** Gaertn.

A few plants noted under the shade of *Carvia callosa* along the banks of Vishwamitri. (BEDI 4418).

12. **Ophioglosum nudicaule** Linn.

A few specimens noted on the fort walls on way to Bhadra Kali temple. (BEDI 4570).

DEPARTMENT OF BOTANY,
FACULTY OF SCIENCE,
M. S. UNIVERSITY OF BARODA,
BARODA,
*January* 10, 1968.

S. J. BEDI
S. D. SABNIS
R. P. BHATT

## 30. OCCURRENCE OF *AEGINETIA INDICA* L. var. *ALBA* SANTAPAU

In the note on ' *Aeginetia indica* L. var. *alba* Santapau : A New Record for Northern India ', (*J. Bombay nat. Hist. Soc.* **61** (2) : 471-472), I had stated that ' As soon as the plant shows signs of multiplication, herbarium specimens will be collected for record'.

Additional information is now being provided that sufficiently large number of plants of the white-flowered variety have now been seen in the New Forest area and specimens collected on 17-9-1967 for record. These have been incorporated in the Dehra Dun Herbarium (F.R.I.) under Reg. Nos. 5412/143048, 143049, 143050, 143051.

In addition, colour photographs have also been taken to show the colour differences between the typical purple-flowered species and the white-flowered variety.

New Forest P.O.,
Dehra Dun. K. M. VAID
*December* 14, 1967.

# An Appeal

**Sálim Ali—Loke Ornithological Research Fund**

The amount at the credit of the Sálim Ali—Loke Ornithological Research Fund, established in 1965 with an initial donation of Rs 10,000, now stands at Rs 36,374·60. There is still far to go before the Fund becomes operative, as the rules governing it provide that no grant or award may be made till the corpus reaches Rs 1,00,000 and, thereafter, the corpus shall not be allowed to fall below this sum. The provision is necessary to ensure continuing encouragement of research and to assure research workers that where observations are necessary over a prolonged period financial aid will be forthcoming throughout the period. There is much work to be done in India, and the Bombay Natural History Society is anxious to be in a position, as early as possible, to assist such research.

We appeal to our readers and wellwishers to contribute freely themselves, and to bring our appeal to the notice of other persons and institutions likely to contribute. We are grateful to the donors who have already come forward with their generous contributions, and hope that they will attempt to persuade others, persons and institutions, to help the Society to reach its goal.

Donations should be made to the Bombay Natural History Society for credit to the Sálim Ali—Loke Ornithological Research Fund, and should be addressed to: The Honorary Secretary, Bombay Natural History Society, Hornbill House, Shahid Bhagat Singh Road, Bombay 1-BR.

Intending donors are informed that the Bombay Natural History Society is an institution established for a charitable purpose within the meaning of sub-section (5) of section 80 G of The Income-Tax Act, 1961 (43 of 1961) and donations to it will qualify for rebate of tax under the provisions of that section.

# Announcement

## Jawaharlal Nehru Fellowship

As one of the methods of utilising the funds at their disposal in a manner appropriate to the many-faceted personality of the late Jawaharlal Nehru, the Trustees of the Jawaharlal Nehru Memorial Fund have decided to establish a number of Fellowships to encourage and assist original work of an outstanding character 'in every discipline —the sciences as well as the humanities'. The broad outlines of the scheme are set out in the announcement printed below, which was published by the Trustees on the third death anniversary of Jawaharlal Nehru. The Bombay Natural History Society has been included among the institutions through which applications for Fellowships may be routed to the Trustees.

No time limit has been prescribed; applications may be filed at any time, subject to the limitation that at any one time there shall not be more than twenty-five Fellows. For the present, eligibility for a Fellowship is confined to Indian citizens for work to be done within India. Applications are not required to be in any specified form, but should include:

1. Particulars of the project proposed to be undertaken,
2. The bio-data of the applicant,
3. His experience in the field of specialisation chosen, and
4. Particulars of original work done by him, accompanied by copies of publications, if any.

The Bombay Natural History Society will be glad to consider for recommendation to the Trustees, applications from members and non-members, relating to Natural History subjects. Correspondence should be addressed to: The Honorary Secretary, Bombay Natural History Society, Hornbill House, Shahid Bhagat Singh Road, Bombay 1-BR.

## Eligibility

The Fellowships are open to scholars in every discipline—the sciences as well as the humanities—and also to categories of people who are capable of creative activity but are not normally covered by existing schemes, such as writers, journalists, artists and civil servants. The only criterion is that they should possess proven

capacity for outstanding work, and a real desire to pursue a creative project such as writing a book, monograph, paper, or to explore new possibilities in their chosen field, or to bring their previous training and experience up-to-date. As Jawaharlal Nehru said, 'Man today, as never before in human history, has to live with change as a permanent partner in his activities and his institutions'. This applies even to the most brilliant scholars who frequently need periods, which they can devote entirely to the enrichment of their intellectual capital particularly in view of the speed with which every discipline is developing in this nuclear age. The absence of adequate facilities in our country for such periodical intellectual 'capital formation' is certain to condemn us to perpetual dependence on more advanced countries. While it will not be desirable to lay down any age restrictions, efforts will be made to ensure an adequate number of men and women in their thirties or forties, so that the Fellowships will result in a long period of creativity which would be of benefit to the country. The Fellowship is open, for the present, to Indian citizens and they will have complete freedom to work at places of their choice within India.

## Selection

Great importance is attached to the selection of the first Fellows, as they will set the standard for the future. The Jawaharlal Nehru Fellows will be nominated by a Selection Committee consisting of distinguished persons in different fields appointed every two years by the Jawaharlal Nehru Memorial Fund. The strength of the Selection Committee will not exceed seven, including the Secretary of the Fund who will be an ex-officio member. The Selection Committee will evolve its own mode of procedure, and will try to ensure that the widest possible spectrum of creative talent is involved in these Fellowships.

## The Fellows

The number of Fellows at a given time shall not exceed twenty-five, but in view of the necessity to maintain the highest standards of excellence the Selection Committee need not feel compelled to reach the maximum number. The duration of the Fellowships will vary between one and two years according to the requirements of each individual case.

## The Stipend

The Fellows will be paid a stipend equivalent to one and a half times the emoluments drawn by them at the time of selection, subject to a ceiling of Rs. 3,000/- per month. For non-salaried persons the Selection Committee will have discretion to fix the stipend within the ceiling. The Fellows, will be provided secretarial assistance if necessary and can also undertake travelling to pursue their work. Their actual expenses on these two items and other contingencies will be met by the Fund subject to a maximum of Rs. 10,000/- per annum for each Fellow.

## General

The present scheme of Fellowships represents the core of an idea which is expected to develop and receive elaboration subsequently. It should not be regarded as closed and final, and the intention is that there should be enough flexibility to adapt it to changing national requirements. Such a scheme, in which money is spent in furthering the creative activity of talented Indian rather than on brick and mortar, is well suited to the memory of a man whose love for his country was unique and abiding.

# Notes and News

## Handbook of the Birds of India and Pakistan

Volume 1 of the HANDBOOK OF THE BIRDS OF INDIA AND PAKISTAN, the ten-volume work on which Dr. Sálim Ali and Dr. Dillon Ripley have been engaged for many years past, is announced for publication by the Oxford University Press in August, price Rs. 90. This first volume contains a number of general introductory articles and describes 224 forms. There are 18 coloured plates, 47 distribution maps, one physical map and many figures in the text.

THE HANDBOOK OF THE BIRDS OF INDIA AND PAKISTAN is more than a revision of E. C. Stuart Baker's FAUNA volumes. Modelled on the HANDBOOK OF BRITISH BIRDS by Witherby and others, it aims to describe the 1200 species of birds which, in nearly 2100 forms, are at the time of compilation to be seen in the Indo-Pakistan subcontinent. Complete life-histories are not attempted and the HANDBOOK confines itself to recording concisely what is known of the distribution, habits, breeding biology, diet, voice, etc. of the birds in the subcontinent. In this first volume more than half the birds are illustrated in colour, and with the help of these colour plates and the systematic keys that have been provided, the bird-watcher and the scientific ornithologist should be able to identify most of the birds they see and all those that they handle. Distribution maps are given for many of the migratory and spatially restricted forms.

Under the auspices of the Bombay Natural History Society, and with generous assistance from the Government of India and friends in the United States, work on this project has been in progress for many years. Volume 2 (*Megapodes to Crab Plover*) is in the press. Volume 3 (*Stone Curlews to Owls*) has been written, and later volumes are in active preparation.

## Fauna Preservation Society of London: Subscription in India

Arrangements have now been made for members of the Fauna Preservation Society who live in India and are unable to send money abroad to pay their annual subscriptions into a special FPS account in Bombay which has been opened on the Society's behalf by the Bombay Natural History Society. These accumulated subscriptions of Indian members will be used to pay for wildlife conservation projects in India, and Indian members will have the satisfaction of

knowing that their subscriptions will directly benefit the wildlife of their own country.

Please send subscriptions to the Honorary Secretary, Bombay Natural History Society, Hornbill House, Shahid Bhagat Singh Road, Bombay 1-B.R., clearly marked FAUNA PRESERVATION SOCIETY.

**XV International Ornithological Congress**

*Under the patronage of His Royal Highness*
*The Prince of The Netherlands*

SECOND ANNOUNCEMENT

The *dates* for the Congress have been determined as follows:

The Hague 30 August—5 September 1970 (inclusive).

*Congress Fee:* Full Members Dutch Guilders 150,—
Associate Members Dutch Guilders 100,—

Membership of the Congress is open to all ornithologists over the age of 18 years. *Full members* are entitled to attend all functions of the Congress and to receive the Proceedings.

Wives, husbands and children over the age of 18 of full members register as *Associate Members* at a reduced fee, which entitles them to attend all functions, but not to receive the Proceedings.

Restriction of the number of memberships is *not* considered.

After a formal opening on the Sunday evening, 30 August, the rest of the week will be devoted to scientific meetings. These will consist of *Plenary Sessions* in the mornings and *Sectional Sessions* in the afternoons. Some of the Plenary Sessions will have the character of a *Symposium* on well advanced or promising fields of ornithological research; at others recent advances in selected fields of ornithology will be reviewed. Forum discussions in the afternoon will give the opportunity to pay additional attention to the subjects treated in the morning. At the Sectional Sessions short, offered papers will be read. Part of the afternoon sessions will be devoted to special or specialists' meetings.

In addition there will be exhibits, a whole-day excursion on Wednesday and film shows in the evenings.

There will be ample opportunity for informal contacts, but *no excursion* before or after the Congress will be organized.

The Congress will meet in the new buildings of the Netherlands Congress Centre, where all meals (except breakfast) will be served and where each night coffee shops and bars will be open. Accommodation

will be arranged in hotels in the vicinity or on caravan or camping sites, if desired.

Along with the application form a list of hotels with prices will be supplied.

*Application forms* with full details can be obtained from (*note new address*):

The Secretary-General,
XV International Ornithological Congress,
C/O Netherlands Congress Centre,
10, Churchillplein,
The Hague,
The Netherlands.

Completed forms must be returned to the above address not later than 1 May 1970, at which date registration for membership will be closed.

Those wishing to contribute papers for the Sectional Sessions, exhibits or films are requested to apply for the appropriate application sheets *as early as possible* and to have these returned not later than 1 December 1969, after which date unfortunately no papers or films can be accepted, as scrutinizing, section allocation and production of the Abstracts Volume require considerable time.

2 *August*, 1968

PROF. DR. K. H. VOOUS,
*Secretary-General*

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# Journal of the Bombay Natural History Society



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*Editors*

H. SANTAPAU, S.J.,
ZAFAR FUTEHALLY, & J. C. DANIEL



DECEMBER 1968

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2. The MS. should be typed (double spacing) on one side of a sheet only, and the sheets properly numbered.

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# JOURNAL
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# BOMBAY NATURAL HISTORY SOCIETY

1968 DECEMBER Vol. 65 No. 3

# The Birds of Sind : A Review

BY

D. A. Holmes and J. O. Wright

(*With a map*)

It is 45 years since a comprehensive account of the birds of the former province of Sind (West Pakistan) was published. Since then, the environment of the alluvial plains of Sind has been considerably altered by a very extensive spread of irrigation canals, agricultural development and increase in population. These changes are still occurring.

An up-to-date review of the avifauna of the alluvial plains is presented, to indicate changes in status that have resulted from the new environment. The review is based on amateur observations by the authors, who were resident in the province for three years. Most noticeable of the changes is the decline of many of the larger, ' wetland ' species, which is likely to continue. In contrast, it can be assumed that the population of many passerines has increased, while a few species, such as the Koel and Common Indian Nightjar, have extended their range.

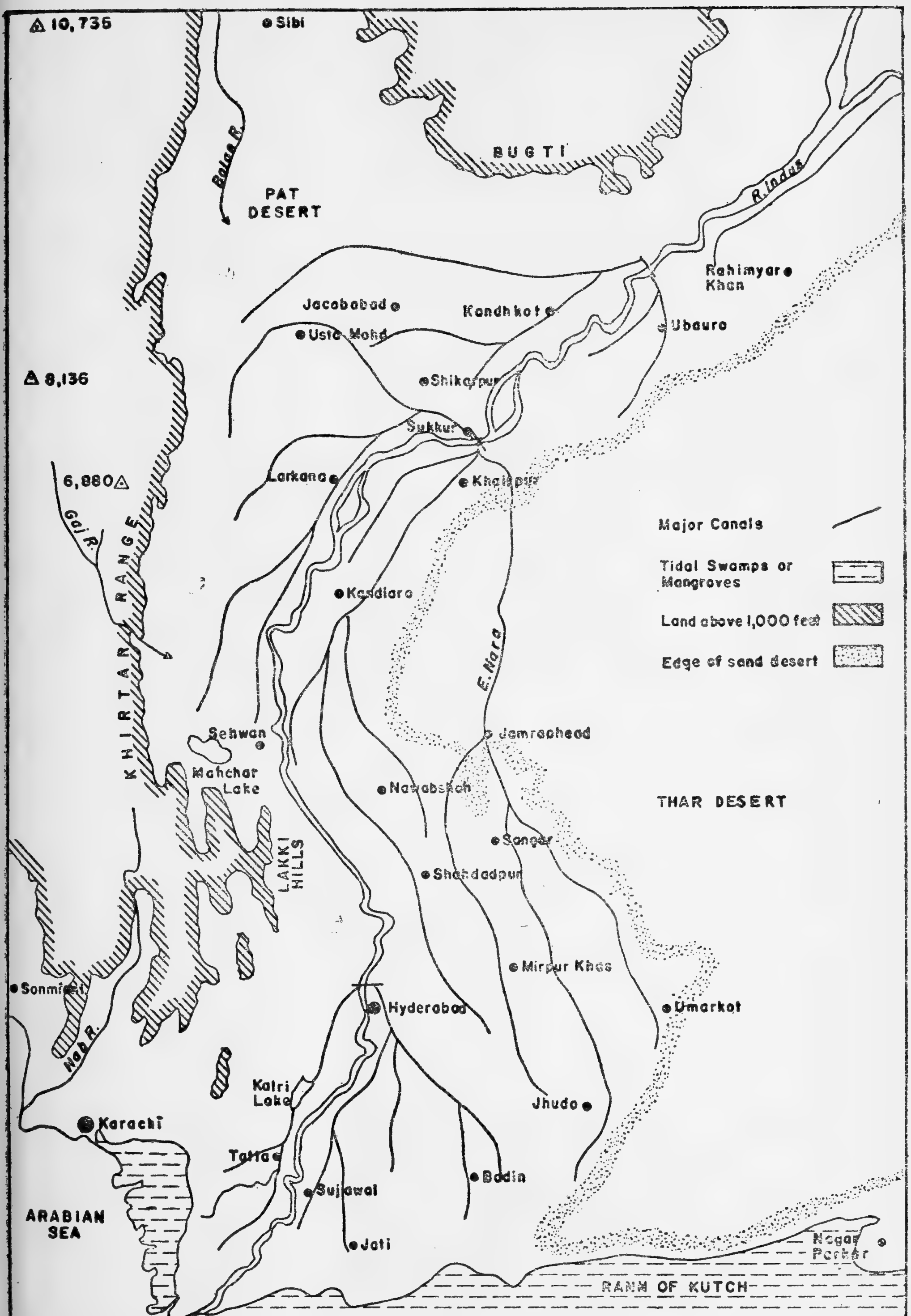
The former province of Sind in West Pakistan has an area of 53,000 sq. miles. About half of this forms part of the great sandy waste of the Thar Desert. The western margins are mountainous, rising to over 7000 feet, while the Arabian Sea and a wide tidal zone form the southern boundary. This review is concerned mainly with the great alluvial plains of the River Indus, which comprise over 20,000 square miles of Sind. The climate is arid and hot, and the plains are barely penetrated by the monsoon. Within this area average annual rainfall ranges from 3 inches in the north to 8 inches in the south. In the north, summer temperatures often exceed 120°F., while frost is sometimes experienced in winter. Temperatures in the south are moderated by the SW winds which blow throughout the summer months. Thus the

plains have a desert climate, and their fertility is dependent upon irrigation from the Indus.

In the middle of the last century, only about 800 square miles, or 4 per cent, of the plains received sufficient irrigation water to permit cultivation. By 1921 this area had increased about four-fold. The first barrage across the Indus was built at Sukkur in 1932, and two more have been added since, so that virtually all the plains are now within irrigation command, a 25-fold increase. It can truly be said that the face of Sind has been changed, and mostly within the last 35 years. In fact, however, less than 15,000 square miles is under cultivation, for while new land is being reclaimed, other land is lost through waterlogging and salinity. Nevertheless huge expanses of formerly monotonous scrubby desert have been replaced by a lush fertility that would have appeared inconceivable 40 years ago. The main crops grown are rice and cotton in summer, and wheat in winter. Accompanying these developments, the population has nearly doubled, from 3½ million in 1931 to 6 million in 1961, and 80 per cent of this is rural. At the same time the network of roads has expanded proportionally, so that all parts of the plains are now readily accessible.

It is 45 years since a comprehensive review of the birds of Sind was published (Ticehurst 1922-1924), and this pre-dates the great developments that have occurred. A number of workers, notably Eates (1937 *et seq.*), have contributed short notes to show some of the changes in the avifauna that were occurring, but time is now ripe for a fresh attempt at a review to be made. The authors were stationed in Sind for three years, from 1963 to 1965, and in the course of carrying out soils and agricultural surveys travelled extensively over the alluvial plains (although not penetrating far into the surrounding regions of sand and rock desert, and tidal mudflats). Ornithology was, however, only a spare time activity, and specimens were not collected, so that inevitably there are gaps in the field identification of some of the more difficult groups. The work of Ticehurst still remains the standard reference to the Sind avifauna, but it is hoped that the review below illustrates the more important changes in distribution that have occurred in some groups.

Without statistical evidence, it is of course impossible to review changes in population quantitatively. For example, the statement that a particular species is 'common and widely distributed in cultivated areas', in both 1922 and 1965, assuming this statement to have the same general meaning, would totally fail to reveal the increase in population that must have occurred. Many of the endemic species that are adapted to or tolerant of a well-populated, agricultural environment must have increased, although the extent cannot be assessed. At the same time, many winter visitors, whether they have increased in numbers or not,




The Alluvial plain of Sind

are dispersed over a much greater area, and thus may give a false impression of reduced numbers.

However, special attention must be paid to those groups that are dwindling, in some cases drastically. The larger ' wetland ' birds are those most affected, for example the storks and ibises, and these are perhaps the wilder birds that would be expected to suffer most from the enormously increased disturbance by man. Readers of Ticehurst's notes will be struck by the impression he gives of sheer numbers, in some species that are now nearly extinct in Sind. We should stress, however, that we rarely penetrated the wild ' no-man's zone ' between land and sea that forms the southern boundary of the province, and there is evidence that this remains the last stronghold in Sind of some remnant populations.

As a result of the changes in the water regime, wetland habitats may have actually increased, and changed in distribution. Within the canal areas, there are over 900 square miles of swampy and flooded land, although over half of this is only seasonally wet. This figure does not include the great Sind lakes, such as Manchar and Kalri, and the wide area between the flood protection bunds of the Indus, a large proportion of which is flooded each summer. The rise in water-tables has meant that many natural depressions, often formerly used for rice crops, are now swampy, or have become jheels. Such jheels are especially common in the plains south of Hyderabad (e.g. Muradani Dhand, in Tatta District) and in some districts in the north, west of the Indus (e.g. Habibkot, near Sukkur). In addition, pools of waste irrigation water, often very saline, as well as the rice fields in late summer and the partially dry beds of seasonal canals in winter, form ideal habitats for waders. The larger lakes are mostly distributed around the margins of the plain : Haleji, Hadeiro, Jhol and Kalri are a notable group near Tatta. Haleji and Kalri are now fresh-water storage lakes, but the seepage zones outside their containing bunds often have shallow saline pools that are more like the waters of Hadeiro and Jhol. Manchar Lake near Sehwan is well known, but its area has diminished since floods have been controlled. In the east, there are several lakes, some of them deep, lying between the sandhills at the edge of the Thar Desert, but we could only visit one or two of them. With future development, the acreages of surface fresh-water storage areas is likely to be increased, but artificial drainage may drastically diminish the natural jheels and swampy areas.

The list that follows is placed in the order of Ripley (1961). The notes are concerned mostly with distribution and status with particular reference to the alluvial plains, and bracketed negative records are included where appropriate. Place-names are shown in the sketch map.

**Podiceps cristatus** (Linnaeus). Great Crested Grebe

Ticehurst saw this bird on the coast, but never inland in Sind, and mentions only one inland record, at Manchar Lake in January in the last century. Ripley does not name West Pakistan in its wintering range. Our only records are inland, at Hadeiro, in the summer of 1965. There was a party of 4 on May 23, which had increased to 10 on June 27.

[**Podiceps caspicus** (Hablizl). Blacknecked Grebe

We never saw this Grebe, but Ticehurst saw them at Manchar Lake, and Roberts (1967) reports seeing several at Kandhkot in February 1965.]

**Podiceps ruficollis** (Pallas). Little Grebe

Common and generally distributed resident. Seen on the nest near Hyderabad in early July.

**Pelecanus** sp. Pelicans

Pelicans were only observed in the extreme south of Sind, where flocks of up to 150 occur on some lakes (e.g. Muradani), and along the coast. Both the White (*P. onocrotalus*) and Dalmatian (*P. philippensis*) occur, but were not always specifically identified. They are winter visitors, extreme dates being October 10 and February 28 (compare Ticehurst ; November 30 and March 5), except for a party of 25, believed to be White Pelicans, present at Hadeiro as late as May 23 in 1965.

**Phalacrocorax** sp. Cormorants

All three species of cormorants occurring in India are very common in Lower Sind, and outside the breeding season, numbers on lakes where there is extensive flooded tamarisk, such as the Kalri seepage zone, run into thousands. The Indian Shag (*P. fuscicollis*) and Little Cormorant (*P. niger*) are often difficult to distinguish at a distance, and like Ticehurst we cannot be sure of the distribution of the Shag in Upper Sind, where the Little Cormorant is probably more widespread than the other two species.

**Anhinga rufa** (Daudin). Darter

Common and widely distributed in small numbers, and not necessarily confined to the larger jheels as stated by Ticehurst, for we have met it in pools in inundated forests etc.

**Ardea cinerea** Linnaeus. Grey Heron

**Ardea purpurea** Linnaeus. Purple Heron

Both species are common residents, but the Purple Heron, which is usually seen in two's or three's near reed beds, is the more widely distributed bird.

**Butorides striatus** (Linnaeus). Little Green Heron

Due to its secretive crepuscular habits, this heron was seen infrequently but it must be a common bird of the seasonally inundated swamps and forests along the river, where most of our records were obtained. On rare occasions, however, they can be seen at the open water edge in broad daylight. In the field, this bird never struck either of us as having the green gloss to the plumage from which it is named. In late June, a nest with 2 eggs was found in a back-water near Sukkur, in a dense acacia bush overhanging the water.

**Ardeola grayii** (Sykes). Pond Heron

Very widely distributed, favouring small ponds and wet thickets, but also occurring commonly in the mangrove swamps at Karachi. Small breeding colonies were found near Sukkur in late May and June, in canal-side *Dalbergia* trees, and in a Cattle Egret colony.

**Bubulcus ibis** (Linnaeus). Cattle Egret

A very common bird of the irrigated tracts, generally in parties or small flocks. Ticehurst found it far commoner in Upper Sind than further south, but this is no longer true following the spread of irrigation supplies to Lower Sind.

In the breeding season they are rarely seen far from their breeding colonies. One such colony of several hundred nests was located in the riverain forests just above Sukkur on May 25, 1964, with up to 5 or 6 nests in some trees, and some of these already contained well-grown nestlings. Several sitting birds were noted without the buff nuptial plumes. The breeding season would appear to be earlier here than over northern India generally, and may depend on the Indus inundation rather than on the monsoon which barely reaches Sind. In the heat of the day, parents were seen to fly to and fro from the river, apparently bringing water in the down of their breasts to the nests or chicks.

**Egretta alba** (Linnaeus). Large Egret

Widely although thinly distributed, and usually seen singly, or in two's or three's. A few also frequent the tidal mudflats and mangroves.

[**Egretta intermedia** (Wagler). Smaller Egret

We have probably overlooked this egret, as Roberts reports having seen it quite commonly at Kandhkot.]

**Egretta garzetta** (Linnaeus). Little Egret

Generally distributed but probably not as numerous as the Cattle Egret. A few nests were found in the Cattle Egret colony in May, and others were seen later in early July.

**Egretta gularis** (Bosc). Indian Reef Heron

A very common bird along the coast, where the majority are dark phase birds (although white phase birds are apt to be mistaken for other egrets). Ticehurst notes that they only occasionally stray a little way inland, but we saw two's or three's with surprising regularity in wet, saline districts in Lower Sind, and on three occasions at Hyderabad. Two were seen at Sehwan in August, nearly 200 miles up the river, but Roberts has seen over two dozen captive birds with the fishermen on nearby Manchar Lake.

**Nycticorax nycticorax** (Linnaeus). Night Heron

Common and widely distributed in waterlogged districts, especially in the south. Muradani in February contained at least 500 birds in the flooded tamarisk, the majority being immature. Being crepuscular, they can be easily overlooked, but their harsh croaks in the dusk reveal the birds flighting overhead to their feeding grounds.

[**Ixobrychus minutus** (Linnaeus). Little Bittern

According to Ticehurst, who only once saw it himself, the Little Bittern is a permanent but uncommon and local resident. We never saw it, although constantly looking for it, but Roberts saw a female at Manchar Lake in December 1966.]

**Ixobrychus cinnamomeus** (Gmelin). Chestnut Bittern

This is the most widely distributed of the small bitterns, occurring quite commonly in reed beds, but also occasionally in wet thickets beside canals etc., and is probably resident. Like the other bitterns, it is overlooked unless dusk or dawn watches are kept over reed beds, although the patient observer hidden in the reeds even by day is sometimes rewarded. A short view of a bird in flight, the most usual view, is generally sufficient for identification, for the upper parts appear a uniform chestnut-brown (richer in the male), without streaking, and with no black on the wing. Underparts are paler, with a dark mid-ventral streak in the male.

**Ixobrychus sinensis** (Gmelin). Yellow Bittern

This bittern is more confined to reed beds than the previous bird, although these need not be large. All our records are between May and August, so it is possibly a summer visitor. Even from a short view in flight, the uniform tawny-buff plumage with black primaries is quite distinctive.

**Dupetor flavicollis** (Latham). Black Bittern

The Black Bittern is more local than the previous two forms ; we found them to be quite common at Jamraohead and around Sujawal, but have only scattered records elsewhere. Ticehurst himself never

saw it, but presumed from earlier records that it was a resident bird, although our records are all between May and August. It appears rather larger than *Ixobrychus*, and being apparently all black, it can readily be mistaken in the late dusk, for other black water birds flying over the reeds. A closer view reveals yellow sides to the throat.

**Botaurus stellaris** (Linnaeus). Bittern

A winter visitor to reed beds, seen occasionally near Sukkur, and once at Jati, in December and February.

**Ibis leucocephalus** (Pennant). Painted Stork

Our only record is of two at Manchar Lake in August 1965. Although it may still be quite common in the tidal zone it has decreased drastically, as Ticehurst found it ' common wherever there are jheels of any size ' in Central and Lower Sind, ' usually in small flocks of a dozen or so'. They formerly bred in the East Nara District.

[**Anastomus oscitans** (Boddaert). Openbill Stork

We never found the Openbill Stork, although Ticehurst considered it to be a ' fairly common bird in the " watery " parts of Sind . . . . round the edges of most jheels of any size ', breeding in the East Nara District.]

[**Ciconia episcopus** (Boddaert). Whitenecked Stork

The only record for Sind is of one at Sukkur in 1879. Neither Ticehurst nor we recorded it.]

**Ciconia ciconia** (Linnaeus). White Stork

Ticehurst considered that the White Stork was a rather uncommon winter visitor. It is certainly scarce now, although one or two are occasionally seen in winter in Lower Sind (we also saw 2 at Sujawal as late as May 9). However, the presence of a flock of over 300 in a jheel near Ladiun in November suggests that they may still visit the delta zone quite commonly.

**Ciconia nigra** (Linnaeus). Black Stork

The decline of the Black Stork seems to have been in progress early in the century, as Hume in the last century met vast numbers along the Indus, whereas Ticehurst only saw it occasionally. We have only three records, all of single birds in November and February.

**Xenorhynchus asiaticus** (Latham). Blacknecked Stork

A very sparse resident along the sand banks of the Indus; we have also seen it along the coast, and a family party of one adult and three immatures at Manchar Lake in August (our most northerly record).

Ticehurst considered it to be not uncommon in the better-watered parts of Central and Lower Sind.

[**Leptoptilos dubius** (Gmelin). Adjutant

Like the Black Stork, the Adjutant had already declined prior to Ticehurst's time, for neither he nor we have seen it in Sind.]

**Threskiornis melanocephala** (Latham). White Ibis

Ticehurst states that this ' is pretty common on the inland waters, and on some jheels large flocks are to be met with '. It bred in the East Nara District. It is now apparently confined to the delta, where it is still said to breed. Apart from 2 birds south of Badin, our only record is of a flock of about 200 on a jheel near Ladiun in November 1965.

**Pseudibis papillosa** (Temminck). Black Ibis

A solitary bird seen along a tree-lined canal near Sukkur in September 1964 is poor comparison to Ticehurst's statement that ' the Black Ibis is very common in the better-watered parts, and large flocks may be met with around most jheels '. Occasional birds may still breed in the delta, although we failed to see it at Ladiun.

**Plegadis falcinellus** (Linnaeus). Glossy Ibis

This ibis does at least seem to be still maintaining its distribution in Lower Sind, where flocks of 300 or 400 are occasionally met with feeding in irrigated fields or around undisturbed jheels. Small parties were seen regularly in the seepage zone of Kalri Lake. Our most northerly records are from Manchar Lake. Nevertheless numbers have declined very considerably since Ticehurst's time.

**Platalea leucorodia** Linnaeus. Spoonbill

The Spoonbill is still quite common in Lower Sind, and parties of 20 or 30 were seen throughout the summer at Kalri or Hadeiro, with numbers increasing to over 100 on some lakes in winter. Still this does not bear comparison with the ' serried ranks ' and ' vast concourse ' described by Ticehurst, constituting ' one of the ornithological sights of Sind.' We never saw the spoonbill north of Hyderabad.

**Phoenicopterus roseus** Pallas. Flamingo

Flamingos can be seen at most seasons in Lower Sind (we have no records north of Hyderabad), notably at Kalri Lake and adjacent jheels, or in small parties scattered along the desolate coastline adjoining the Rann of Kutch. There is no better or easier place to watch them than from the high bund of Kalri Lake, as they roost or feed desultorily in the seepage zone below you.

During 1965, we kept a tally of numbers at the three lakes of Kalri, Jhol and Hadeiro, and from about a hundred at Kalri Lake in February, numbers rose steadily to an estimate of some 2,500 at the three lakes on May 30. Numbers then dropped slowly, to less than a hundred in August, when they may have been shifting back to their assumed origin in the Rann of Kutch to breed. Less than 50 per cent of these birds were in adult plumage, although the proportion of adult birds increased as the numbers dwindled. There is a possibility that some flamingos in winter are visitors from a more northerly breeding ground.

[We never identified the Lesser Flamingo (*Phoeniconaias minor*) amongst these flocks.]

[**Anser** spp. Geese

There is no doubt that wintering geese have declined very considerably, and perhaps quite recently, and when questioned local wildfowlers will comment on this. We ourselves never saw any, but Greylag (*A. anser*) are said to be still common in some years on the coast. A wildfowl survey of the sub-continent is currently being undertaken by C.D.W. Savage, under the auspices of the Wildfowl Trust (1965).]

[**Cygnus** spp. Swans

Stragglers of all three species have been recorded from Sind, although we have no records or reports of any.]

**Dendrocygna javanica** (Horsfield). Lesser Whistling Teal

This duck was considered by Ticehurst to be a permanent resident, but apart from flocks of 50 to 100 in Tatta District in November, all our records were between May and September. Some may well be overlooked in the packs of winter wildfowl, and probably a fair number do over-winter, especially in the south. However, one of their main summer strongholds is the great stretch of inundated riverain forests that extend along the length of the Indus, and as these forests are only flooded in summer, the bird is here a summer visitor, (although it is scarce in Upper Sind). They arrive in the second half of May, and for a few weeks can be seen each evening in fair numbers, before they become dispersed over their summer territories.

[We never identified the Large Whistling Teal (*D. bicolor*) amongst these parties, although a few might be expected.]

**Tadorna ferruginea** (Pallas). Ruddy Sheld-duck

This is now a scarce winter visitor, and certainly rarer than formerly as Ticehurst considered it ' much commoner in Upper than in Lower Sind '.

**Tadorna tadorna** (Linnaeus). Common Sheld-duck

This is also scarce, and we only saw them a few times on Kalri Lake, in very small numbers. However, they are reported to be not uncommon in Lower Sind in some winters.

**Anas angustirostris** Ménétriès. Marbled Teal

According to Ticehurst, this was formerly a pretty common duck on shallow-water jheels in Central Sind, and some may have bred occasionally at Manchar Lake. J.O.W. saw several pairs at a small jheel at Tando Musti Khan, near Khairpur, in March 1965, and these may well have been breeding. Local wildfowlers reported that they were year-round residents, to be found only on this particular jheel.

**Anas acuta** Linnaeus. Pintail

This is one of the commonest ducks that visit the Sind jheels, as indeed it was in Ticehurst's day, numbering over a thousand on many jheels.

**Anas crecca** Linnaeus. Common Teal

The Common Teal is nearly as common as the Pintail, and some wildfowlers suggest that it may be the commonest wildfowl in Upper Sind.

**Anas poecilorhyncha** J. R. Forster. Spotbill Duck

The Spotbill is apparently resident in Lower Sind, where flocks of 20-50 birds may be encountered at almost any season, while some jheels may have 50-100 birds in winter. We never saw it in Upper Sind.

**Anas platyrhynchos** Linnaeus. Mallard

The Mallard is widely distributed, although not very abundant. It prefers shallow water and fairly dense cover, and totals in the reed beds and rushes around suitable jheels probably run into several hundred.

**Anas strepera** Linnaeus. Gadwall

To quote Ticehurst, ' taking Sind as a whole the Gadwall is out-and-out the commonest duck ', in numbers that were ' incredible '. It now appears to be rare over most of Sind, although it is a duck that tends to be overlooked. This species has probably suffered the most noticeable decline of any duck in Sind.

**Anas penelope** Linnaeus. Wigeon

Not as common as the Pintail and Teal, but a few jheels in the south may hold well over 500 Wigeon. In 1965, they remained at Kalri Lake well into April, and there were 5 drakes at nearby Jhol on May 16.

**Anas querquedula** Linnaeus. Garganey

The Garganey is mainly a passage migrant, passing through Sind from mid-September to mid-November, and again from mid-February to mid-April. At these seasons they are fairly common. Probably a few over-winter, and in 1965 a pair was seen at Jhol on May 16.

**Anas clypeata** Linnaeus. Shoveller

The Shoveller is an abundant winter visitor, and although not as common as the Pintail and Common Teal, some jheels may hold well over 500 birds. Two drakes were seen at Khairpur as late as June 1 in 1964, and two remained until the end of May at Jhol in 1965.

**Netta rufina** (Pallas). Redcrested Pochard

This duck is now generally very scarce, and has clearly decreased since Ticehurst's time. However, it may still be quite common in some years on deeper jheels around Larkana and Kandhkot, and in the desert fringe east of Sanghar. In 1964, J.O.W. saw two drakes near Sukkur as late as June 7.

**Aythya ferina** (Linnaeus). Common Pochard

This is the commonest of the diving duck, and large sheets of water may hold flocks of up to 500 birds. However, numbers have probably declined slightly, since Ticehurst records ' vast flocks '.

**Aythya nyroca** (Güldenstädt). White-eyed Pochard

Although probably overlooked, this pochard has declined drastically, as Ticehurst found it ' one of the most universally distributed and numerically abundant species ', and Sálim Ali (1928) thought it to be the commonest duck at Manchar Lake. Perhaps only in some years, quite large numbers are still found on some jheels. Several were seen near Sukkur at the end of May in 1964, with one duck as late as June 7.

**Aythya fuligula** (Linnaeus). Tufted Duck

The Tufted Duck is slightly less common than the Common Pochard, but favours the same deep, open water. 5 birds were seen at Kalri Lake on August 1, 1965.

**Nettapus coromandelianus** (Gmelin). Cotton Teal

Apparently Ticehurst never himself saw this duck in Sind, and it is certainly rare and local, perhaps confined to Lower Sind. Our only record is of a party of 8 at Sujawal in May 1965. Sujawal District is probably the stronghold of several of the endemic wildfowl. C.D.W. Savage (personal communication) reported them at Haleji Lake in July, and in some winters it is reported to be quite widely distributed in south-west Sind.

[**Sarkidiornis melanotos** (Pennant). Nukhta

We ourselves never found the Nukhta, but it is reported to be still a sparse resident along the Indus, and possibly around Sujawal, in Lower Sind.]

[**Mergus albellus** Linnaeus. Smew

Roberts reports that one or two have been recorded lately at Manchar and near Sanghar, but we never saw it.]

**Mergus merganser** Linnaeus. Goosander

Our only record of sawbills is of a female, believed to be of this species, seen by J.O.W. on the Indus at Sukkur in February 1965.

**Elanus caeruleus** (Desfontaines). Blackwinged Kite

This is one species that may have benefitted from the agricultural development of Sind, for it was formerly rather uncommon. It is now a widely, although thinly, distributed resident in the cultivated districts.

**Milvus migrans** (Boddaert). Black Kite

Abundant in towns and villages. Numbers increase in winter, when the Blackeared race (*M. m. lineatus*) is also encountered.

**Haliastur indus** (Boddaert). Brahminy Kite

Widely distributed in small numbers near water, including the canals.

**Accipiter badius** (Gmelin). Shikra

**Accipiter nisus** (Linnaeus). Sparrow-Hawk

The two are treated together, as we could never be certain of their separation in the field. The Shikra is the resident bird, and young were heard in the nest near Sukkur at the end of May. The Sparrow-Hawk is a winter visitor. They are thinly distributed in well-timbered cultivated districts.

**Buteo rufinus** (Cretzschmar). Long-legged Buzzard

There is an urgent need for a comprehensive field-guide to Indian birds of prey, and the buzzards and eagles especially present considerable problems to the amateur in the field. The Long-legged Buzzard is the only buzzard that we have certainly identified, and is quite a common winter visitor, affecting desert, cultivation and jheels alike, as noted by Ticehurst.

**Butastur teesa** (Franklin). White-eyed Buzzard-Eagle

Common resident, especially in well-timbered cultivated districts.

**Nisaetus fasciatus** (Vieillot). Bonelli's Hawk-Eagle

According to Ticehurst, this was a common resident of the Indus inundations and jheels. We have only few records, but may well have over-looked it, for Roberts suggests that it may be not uncommon.

[We never identified the Booted Hawk-Eagle (*Hieraaetus pennatus*) in Sind.]

[**Aquila heliaca** Savigny. Imperial Eagle

Roberts has recorded this eagle at Manchar Lake and in the tidal creeks at Karachi, as well as in the Khirtar Hills, but we never certainly identified it.]

**Aquila rapax** (Temminck). Tawny Eagle

The Tawny Eagle is the most widely distributed eagle in Sind, and certainly the commonest resident, favouring cultivation, including quite dry areas. Immatures are common in May.

[The Steppe Eagle (*Aquila nipalensis*) was not identified, but may be a winter visitor to jheels.]

**Aquila clanga** Pallas. Greater Spotted Eagle

This is a common winter visitor to jheels, and a few may be resident. Eates (1937) has described the status of this and other eagles in Sind. At the end of November, 1963, a small scale migration was apparently in progress near Jati.

**Haliaeetus leucoryphus** (Pallas). Pallas's Fishing Eagle

Thinly distributed on the larger jheels and on the Indus. Nestlings are present in February.

**Torgos calvus** (Scopoli). Black or Pondicherry Vulture

[This should not be confused with the Black Vulture (*Aegypius monachus*) of Europe, named Cinereous Vulture in Ripley.]

This vulture, which according to Ticehurst was fairly common in the canal areas, has now nearly deserted Sind, for our only record is of one seen by D.A.H. at Jati in December 1963.

**Aegypius monachus** (Linnaeus). Cinereous Vulture

A winter visitor in small numbers to Karachi.

**Gyps fulvus** (Hablizl). Griffon Vulture

One or two may generally be seen with Whitebacked Vultures at most carcases and roosts, and it is a common visitor to the Karachi rubbish tips, although it probably does not breed in the plains.

**Gyps bengalensis** (Gmelin). Indian Whitebacked Vulture

West Pakistan is erroneously omitted from the range of this vulture in Ripley, (see Waite, 1962) but it is in fact the most widely distributed vulture in Sind, in the plains and adjacent desert areas. They breed colonially in winter, perhaps commencing in October, while a few may still be breeding in June.

**Neophron percnopterus** (Linnaeus). Egyptian Vulture

Very common, especially around towns and villages. Nesting has been observed, on tombs, in May, but numbers decline in Upper Sind in summer.

**Gypaetus barbatus** (Linnaeus). Bearded Vulture

Found only in the Khirtar Range, where Roberts has seen it in January as low as 1800 feet. (In the Bolan Pass, on the road to Quetta, J.O.W. has seen them below 1000 feet in winter.)

**Circus** sp. Harriers

Harriers are common winter visitors to Sind, from about mid-September to mid-April. The Marsh Harrier (*C. aeruginosus*) is the commonest, frequenting jheels, but the great majority are female or immature ; very few adult males were seen, although one was present at Kalri Lake on April 17. The other harriers are less easy to identify, but the Pale (*C. macrourus*) and Montagu's (*C. pygargus*) would appear to be commoner than the Hen Harrier (*C. cyaneus*). [We never saw the Pied Harrier (*C. melanoleucos*).]

**Circaetus gallicus** (Gmelin). Short-toed Eagle

Probably rare and local, and only definitely seen twice, in desert scrub near Karachi and over a swamp near Jati.

[**Spilornis cheela** Crested Serpent Eagle

Never seen by us, and Ticehurst knew of only two records in Sind.]

**Pandion haliaetus** (Linnaeus). Osprey

A common winter visitor to the Indus, jheels, and the coast, a few birds remaining until early May.

**Falco biarmicus** Temminck. Lanner Falcon

A rather sparse resident, in cultivation and desert scrub, and even sometimes on the outskirts of towns. The only form identified by us is the Laggar Falcon (*F. b. jugger*).

**Falco peregrinus** Tunstall. Peregrine Falcon

A winter visitor in small numbers, generally to jheels.

**Falco subbuteo** Linnaeus. Hobby

One record only, of a fine male on a low, barren jebel at Hyderabad on April 23.

[We did not find the Merlin (*Falco columbarius*) which must be only a rare visitant.]

**Falco chicquera** Daudin. Redheaded Merlin

Resident in small numbers in cultivated areas, perhaps commoner in Upper than Lower Sind.

**Falco tinnunculus** Linnaeus. Kestrel

A not uncommon winter visitor, favouring desert scrub, sides of jebels etc. One near Karachi on September 29 is the earliest arrival date.

[**Ammoperdix griseogularis** (J. F. Brandt). Seesee Partridge

Not recorded by ourselves, but presumably still occurs in the Khirtar hills, together with the Chukor Partridge (*Alectoris graeca*).]

**Francolinus francolinus** (Linnaeus). Black Partridge

Common and widely distributed in the damp and wooded areas, but perhaps not as abundant as in Ticehurst's day.

**Francolinus pondicerianus** (Gmelin). Grey Partridge

Commoner than the Black Partridge. It prefers drier land, even desert scrub, although we have flushed them from trees in the forests at Sukkur when these were flooded.

**Coturnix coturnix** (Linnaeus). Common Quail

We did not find Quail common, although doubtless large numbers are overlooked unless they are beaten up. Our scattered records are all from mid-September to mid-April, and as Ticehurst suggests, the majority are likely to be passage migrants. We heard the calls in September and February, but Ticehurst points out that they can be heard at any season.

[We have no records of the Rain Quail (*C. coromandelica*).]

**Pavo cristatus** Linnaeus. Common Peafowl

Originally introduced into Sind, it appears to be common in the wild state only in S.E. Sind (approximately east of a line from Shahdadpur-Hyderabad-Badin).

[We have no record of Bustard-Quails (*Turnix* sp.).]

**Grus grus** (Linnaeus). Common Crane

Cranes are now rather uncommon winter visitors, and our records are all from south of Hyderabad, of small parties around jheels or on

the coast, or on migration in September and March. Probably they are still common on the coast, but have apparently declined considerably. The only cranes identified have been of this species, but doubtless the Demoiselle Crane (*Anthropoides virgo*) occurs also. [The Sarus Crane (*Grus antigone*) and Great White Crane (*G. leucogeranus*) must now be only vagrant to Sind.]

**Rallus aquaticus** Linnaeus. Water Rail

A rare winter visitor, our only record is of several near Sukkur on November 11, 1964.

**Porzana** sp. Crakes

Crakes are seen quite commonly in reed beds in winter, but only rarely with a sufficiently good view for identification. Both the Little Crake (*P. parva*) and Spotted Crake (*P. porzana*) were identified in the Sukkur area. [Ticehurst also records Baillon's Crake (*P. pusilla*) in Sind.]

**Amaurornis phoenicurus** (Pennant). Whitebreasted Waterhen

A common resident of irrigated districts, especially the wetter areas, favouring especially the shallow swampy sides of canals, breeding through the summer.

**Gallicrex cinerea** (Gmelin). Water Cock

The Water Cock or Kora was previously known from a very few records only, and Ticehurst did not find it. During our first two years, we had only one unconfirmed record, near Sujawal in Lower Sind, in June 1963. However, on June 6, 1965, we saw two males in the same area, and subsequently we found them throughout June and July at virtually every swamp we visited in Lower Sind, often in some numbers, until our field trips ceased in August. The most northerly record was at the barrage at Hyderabad. Only on one occasion was a solitary female seen, the rest all being noisy and aggressive males.

It is not possible to define its status from these records, but probably it is increasing sharply in Lower Sind, as a summer visitor (in numbers that vary from year to year). Visits to the same swamps in 1965 prior to June failed to reveal any. However, local people are familiar with the bird, under the name ' tubar '.

**Gallinula chloropus** (Linnaeus). Moorhen

Quite a common and generally distributed resident, although Ticehurst found it rather scarce in Central and Lower Sind.

**Porphyrio porphyrio** (Linnaeus). Purple Moorhen

Widely distributed and very common in jheels with plentiful reeds

and rushes, especially where lotus lilies are growing. They are readily flushed with much clattering of wings and reeds, while any sudden noise will set them off in a raucous clamour. There appears to be some local movement, perhaps as a result of variations in water levels.

**Fulica atra** Linnaeus. Coot

An abundant winter visitor to open jheels. We did not see the vast herds of Coot that Ticehurst recorded, although Kalri Lake has several thousands in winter. Ticehurst states that they do not breed in Sind, and his latest date was May 5. However, small numbers certainly over-summer, and a few may well breed.

**[Bustards**

Bustards seem to be declining rapidly, and we saw neither bustards nor the Lesser Florican (*Sypheotides indica*), which was formerly a rains visitor. The Great Indian Bustard (*Choriotis nigriceps*) was formerly not uncommon in the east of Sind, and Roberts reports that one was shot in recent years near the Rajasthan border. However, we had several reports that the Houbara (*Chlamydotis undulata*) still arrives in Sind in small numbers in September.]

**Hydrophasianus chirurgus** (Scopoli). Pheasant-tailed Jacana

Common on shallow jheels with plentiful rushes, lotus etc.

**Haematopus ostralegus** Linnaeus. Oyster catcher

A winter visitor to Karachi harbour, a few over-summering.

**Vanellus leucurus** (Lichtenstein). Whitetailed Lapwing

A fairly common winter visitor to marshes and margins of jheels throughout Sind. Most had left by the end of March.

**[Vanellus vanellus** (Linnaeus). Lapwing or Peewit

Not recorded by us, but according to Roberts it is a common visitor, at any rate in some years, to Kandhkot in Upper Sind. We have no knowledge of the Sociable Lapwing (*V. gregarius*) in Sind.]

**Vanellus indicus** (Boddaert). Redwattled Lapwing

Widely distributed throughout the irrigated and damper parts of the province. Young chicks were seen as far apart as late-March and late-August.

**Vanellus malabaricus** (Boddaert). Yellow-wattled Lapwing

Ticehurst states that this lapwing is virtually unknown in Sind outside the drier areas of Lower Sind and the Karachi area, where it is a

summer visitor. We have only seen it at Landi, near Karachi, in summer, in small numbers along the margins of the cultivated Malir valley, and adjacent desert scrub. It especially favours fallow fields.

**Pluvialis squatarola** (Linnaeus). Grey Plover

A winter visitor in comparatively small numbers, to the coast and occasionally to jheels inland in Lower Sind. A few over-summer on the coast in winter dress.

**Pluvialis dominica** (P. L. S. Müller). Eastern Golden Plover

Our only records of Golden Plovers are of a party of 8 at Jhol as late as May 16, 1965, and a few at Hadeiro on May 23. All had left by May 30. Some of these had attained breeding plumage, and appeared to be of this form, and not *P. apricaria*, which is known from only very few records in Sind. Ticehurst found *P. dominica* uncommon, and his latest date was March 12.

**Charadrius leschenaultii** Lesson. Large Sand Plover

A common winter visitor to the coast, it is less common than *C. mongolus*, and was not identified among the parties of the latter bird inland.

**Charadrius hiaticula** Linnaeus. Ringed Plover

Our only record of this rare coastal visitor was of a solitary bird at Jhol on May 16, 1965, well seen at close range.

**Charadrius dubius** Scopoli. Little Ringed Plover

A winter visitor and very common passage migrant, while some (*C. d. jerdoni*) are resident along the Indus sand banks.

**Charadrius alexandrinus** Linnaeus. Kentish Plover

A common resident, favouring especially the coast, but also the sandy shores of the Indus and canals, and saline flats surrounding jheels. Breeding was suspected on the coast in April, and at Jhol in May.

**Charadrius mongolus** Pallas. Lesser Sand Plover

As stated by Ticehurst, this is one of the commonest, if not the commonest, wader wintering on the coast, but, according to him, unknown in the rest of Sind. In the spring of 1965, there was a sizeable passage through the more saline jheel margins of Lower Sind. On May 16, it was the commonest wader at Jhol, mostly in moult, but with a few in full breeding plumage. On May 28, there was a party of 30 in a saline mud-flat by the road to the barrage at Hyderabad. Numbers were declining by May 30, with some 50 at Jhol and 100 at Hadeiro, and the last seen was one at Hyderabad on June 12. These records

were during a period of inland passage of several species of coastal waders.

**Numenius phaeopus** (Linnaeus). Whimbrel

A visitor to the coast, mostly as a passage migrant, we have seen one at Kalri Lake as early as July 18.

**Numenius arquata** (Linnaeus). Curlew

A common winter visitor to the coast, and to jheels near the coast, where flocks of a hundred or more may be seen, but rather scarce and local elsewhere in Sind.

**Limosa limosa** (Linnaeus). Blacktailed Godwit

An abundant winter visitor to jheels, where flocks of hundreds, or even thousands, are encountered in suitable terrain. Several hundreds were present at Kalri, Jhol and Hadeiro lakes in the second half of May, 1965 (with most birds having only limited amounts of the summer dress showing through). At the end of June, there was still some 150 on these waters, but less than a quarter of that in July ; numbers were rising again by mid-August.

**Limosa lapponica** (Linnaeus). Bartailed Godwit

A winter visitor to the coast, but neither Ticehurst nor we saw it inland. However, Roberts has a record from Kandhkot.

**Tringa erythropus** (Pallas). Spotted Redshank

A common winter visitor. It is strange that Ticehurst found it very rare in Lower Sind, as it seems now to be just as common as further north, and occasionally figures as one of the commonest waders at shallow, reedy jheels. They become scarce later in April, but the few that stay around, through to late-May, are in fine summer plumage.

**Tringa totanus** (Linnaeus). Common Redshank

A fairly common winter visitor, widely distributed in rather small numbers. Apart from a few on the coast, our extreme dates are August 1 and May 15.

**Tringa stagnatilis** (Bechstein). Marsh Sandpiper

It was not until early March, 1965, that we became aware of this species, and from then to about mid-April, they were seen commonly, in parties of 30 or so, and sometimes numbering up to 200 along about a mile of the nearly dry Pinyari Canal. Odd birds linger through to June, and the return migration commenced at the end of July. It would appear to be more of a passage migrant than a winter visitor.

**Tringa nebularia** (Gunnerus). Greenshank

A common and widely distributed visitor, especially on passage. They are met with in groups or small parties, although combined numbers may be quite high on any one stretch of water. Very few remain through June, but in 1965 the return passage was heard to commence on July 20, (during a night thunderstorm).

**Tringa ochropus** Linnaeus. Green Sandpiper

A very common visitor, with one or two birds to be found round every patch of stagnant water. Probably a greater number are passage migrants than winter visitors, and in Lower Sind at least, they are never as common as the Wood Sandpiper. Very few birds remain through May, although we were very surprised to find a flock of some 40 at Habibkot, near Sukkur, on June 26 ; the return passage is well under way by mid-July, although they are not widespread until August.

**Tringa glareola** Linnaeus. Wood Sandpiper

A winter visitor, and very abundant passage migrant through April to about the third week of May, and early August to about October, when the margins of jheels and the rice-fields are alive with their ringing calls. However, the spring passage was noted to be much less prominent in Upper Sind. We have no records of birds over-summering, but in 1965 the first arrivals were heard with the Greenshank on July 20.

**Tringa terek** (Latham). Terek Sandpiper

A common winter visitor to the coast, which we never found inland.

**Tringa hypoleucos** Linnaeus. Common Sandpiper

A widely distributed visitor, in comparatively small numbers, from the end of July to mid-May, on rivers and open margins of jheels. They are very common in the mangrove swamps at Karachi, resting on the mangroves or on boats at high tide.

**Arenaria interpres** (Linnaeus). Turnstone

A winter visitor to the coast, Ticehurst states that it is unknown inland in Sind. We did, however, find solitary birds in breeding plumage, at Jhol on May 16 and at Hyderabad on May 28, during the period of inland passage of coastal waders already referred to.

**Capella gallinago** (Linnaeus). Fantail Snipe

Very common winter visitor. [We have no records of the Pintail Snipe (*C. stenura*), which is recorded by Ticehurst.]

**Capella minima** (Brünnich). Jack Snipe

Winter visitor, less common than the previous species.

**Scolopax rusticola** Linnaeus. Woodcock

Recorded by Ticehurst as a very rare straggler; we have no records.

[**Calidris tenuirostris** (Horsfield). Eastern Knot

We have no records of this winter visitor to the coast, but Roberts states that it is not uncommon near Karachi, up to late-April.]

**Calidris albus** (Pallas). Sanderling

A winter visitor to the coast, which we rarely visited, but a few were seen near Karachi on May 23, in various plumage phases.

**Calidris minutus** (Leisler). Little Stint

**Calidris temminckii** (Leisler). Temminck's Stint

These two stints are treated together, being confusing in the field unless carefully separated. Both are abundant in winter and on passage on the muddy edges of pools and jheels. Quite large flocks are encountered at times of passage (e.g. 500 on a pool near Hyderabad on May 15, and already 100 there on July 27). From the end of March, stints are beginning to develop summer plumage.

**Calidris alpinus** (Linnaeus). Dunlin

A common winter visitor to the coast, where odd birds over-summer (some in summer plumage); they are not very common inland, although we saw small parties in Lower Sind in May (latest date, May 30); on May 23 at Hadeiro, they were one of the commonest small waders, in tight, noisy, high-flying flocks of up to 100 birds, mostly in summer dress. Like many waders, they tend to keep together in these wild little flocks in April and May.

**Calidris testaceus** (Pallas). Curlew-Sandpiper

Like the Dunlin, these are met with inland in Lower Sind on passage, in May (latest date, May 28) and August (earliest date, July 27). These passage birds are nearly all in summer plumage. A few over-summer on the coast in winter dress.

[**Limicola falcinellus** (Pontoppidan). Broadbilled Sandpiper

We have no records of this coastal wintering species.]

**Philomachus pugnax** (Linnaeus). Ruff

Comparatively few over-winter, but on December 15, there was a party of several hundred at a small pool near Jati. They are more commonly seen on passage, from mid-August to October, and late-February to mid-April, generally in small parties, and never in breeding

plumage. Our latest date is April 18, considerably earlier than most waders, and they are later to arrive in the autumn.

**Phalaropus lobatus** (Linnaeus). Rednecked Phalarope

According to Ticehurst, a common winter visitor to the seas off Sind, and regular inland on autumn passage, but he adds that ' on spring passage they naturally do not halt ', and he only saw one inland at that season. We saw a few at Hyderabad in September, whereas there was a sizeable inland passage in May 1965. There were 28 at Hadeiro on May 23, 20 at Hyderabad on May 28, and up to 80 at Jhol on May 30 (but none at Hadeiro). Many were in breeding dress. They were very tame, allowing a close approach as they swam in circles in shallow water.

**Rostratula benghalensis** (Linnaeus). Painted Snipe

A rather rare and local bird, our few records are all in May and June, when several were seen around shallow jheels or in flooded grass in the riverain areas at Sukkur and Hyderabad. An adult male with four well-grown chicks was seen on June 5, but none were seen there after June 12. Roberts has seen it at Manchar, and regularly at Kandhkot, in winter.

**Himantopus himantopus** (Linnaeus). Blackwinged Stilt

A very common winter visitor, from August to May, with many also resident. They are seen in parties or occasionally flocks of a hundred or more, and are widely dispersed over the small jheels and even village ponds. A concentration of some 200 in the seepage zone at Kalri Lake on June 27 suggests that some over-summering birds do not breed, but most in summer are spread out in their territories. In May, birds were seen incubating on small mud mounds in a drying-up pool at Hyderabad, and a family of 4 young chicks was seen there on June 12. The families are fully grown and becoming dispersed by mid-July.

**Recurvirostra avosetta** Linnaeus. Avocet

According to Ticehurst, this is a winter visitor and passage migrant, and apart from a solitary bird on June 22, his extreme dates are August 28 and May 24. However, since it breeds in the Great Rann of Kutch, it is perhaps not surprising that we found large flocks in the Tatta area in the summer of 1965. In fact there were some 620 at Hadeiro on May 30, and a few on adjacent waters. At the end of June and July, numbers were down to about 100 at Kalri, Jhol and Hadeiro (but 38 were seen near Larkana on June 25), and only solitary birds were present in August. By contrast, we have few winter records !

[**Dromas ardeola** Paykull. Crab Plover

Like Ticehurst we did not find this species, although there are records from the coast.]

**Burhinus oedicnemus** (Linnaeus). Stone Curlew

Apparently a resident bird, we have few records, although they are readily overlooked and may, in fact, be quite common in the sandy, tamarisk areas along the Indus. There were apparently two pairs present on an island just below Sukkur barrage in the summer of 1964, although we could never establish that they were breeding. The only other record is of one in February at Sann, on the Indus below Sehwan.

**Esacus magnirostris** (Vieillot). Great Stone Plover

As stated by Ticehurst, this is probably a rare resident bird along the sandy islands of the Indus, and on the coast. We only saw them twice (3 at Sukkur in June, and 1 at Ghizri Creek, Karachi, in April), but probably many more would be found if more of the Indus was readily accessible.

[**Cursorius cursor** (Latham). Creamcoloured Courser

We never saw this courser, which would appear from Ticehurst's notes to be a not uncommon winter visitor.]

**Cursorius coromandelicus** (Gmelin). Indian Courser

A fairly common but local resident in Lower Sind, we never found any in Upper Sind. In the south, their favourite haunts are rather bare, stoney desert scrub (although, as Ticehurst comments, their distribution is patchy), or, east of the Indus, on rather sandy fallow or uncultivated land. They are usually seen singly or in very small parties, and a chick was seen near Badin in late-May.

**Glareola pratincola** (Linnaeus). Collared Pratincole

According to Ticehurst, a summer visitor from March to September in Lower Sind, with breeding colonies around the Tatta lakes and the eastern Nara. We saw none at the former locality, but they were quite common in June along Sir Creek (south of Jati), and between Manchar Lake and Sehwan (although the latter birds had deserted the area by August 14). They may well have been breeding in these localities. Wandering birds were also seen in June near Hyderabad and Sujawal. The Sind birds are presumed to be *G. p. pratincola.*

**Glareola lactea** Temminck. Small Indian Pratincole

This bird is common enough along the Indus, although Ticehurst rarely saw it, but is apparently a summer visitor, as apart from a few at Hyderabad in October, our records are confined to late March to late-

June. In 1964, they were common on the Indus at Sukkur in May and June, but had vanished by July 1, when the river had risen. Their behaviour along the Sukkur waterfront at dusk reminded us rather of bats. At Hyderabad, a colony of about 100 birds was found on the sand banks below the barrage on March 30, where there had been none on February 9. At the end of March, a nest with one egg and another with two chicks were found. By the end of April, they appeared to have finished breeding, the birds were more dispersed, the river was rising rapidly, and no juveniles could be found.

*(to be continued)*

# *Pseudodissochaeta*: A new Genus of Melastomataceae

BY

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(*With a map and four text-figures*)

The genus *Pseudodissochaeta* is proposed for the homogeneous group of species, namely, *Pseudodissochaeta assamica* (C.B.Cl.) Nayar, *P. subsessilis* (Craib) Nayar, *P. lanceata* Nayar and *P. septentrionalis* (W. W. Smith) Nayar, belonging to the tribe Dissochaeteae of the family Melastomataceae. They are small trees or shrubs having eight equal or subequal isomorphous stamens which are dorsally appendiculate and ventrally biauriculate. The genus comprises four species extending from N.E. India through Upper Burma, southern China, North Thailand, N. Vietnam to Hainan. The new combinations are *P. assamica* (C. B. Cl.) Nayar, *P. subsessilis* (Craib) Nayar and *P. septentrionalis* (W. W. Smith) Nayar. A new species *P. lanceata* Nayar is described from Hainan.

## INTRODUCTION

The family Melastomataceae comprises about 220 genera and 5300 species and is mainly confined to the tropical and subtropical regions, avoiding deserts, and attaining prolific growth in the rain forest regions between the Tropic of Cancer and the Tropic of Capricorn. More than one half of the world's genera (about 120) and two-thirds (about 3353) of the total number of species are confined to the New World. The melastomataceous flora of Asia consists of 65 genera and about 1300 species. The author has carried out a taxonomic study of several genera in the Family Melastomataceae. The present paper deals with the new genus *Pseudodissochaeta* belonging to the tribe Dissochaeteae Triana of the family Melastomataceae.

### **Pseudodissochaeta** gen. nov.

Pertinet ad *Dissochaeteas* Triana, affinisque *Dissochaetae* Blume, a qua tamen differt habitu erecto, connectivo vix producto, staminibus ventraliter biauriculatis.

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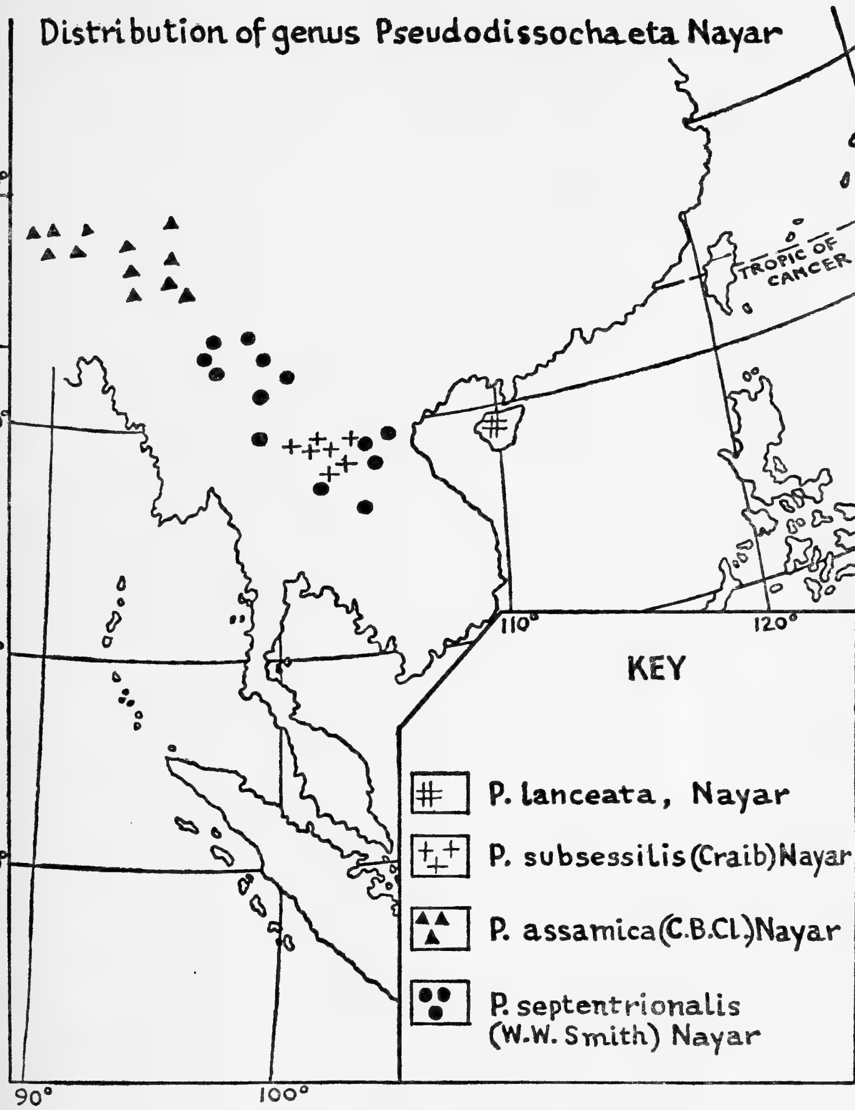
*Frutex* erectus. *Rami* subteretes vel angulati vel quadrangulares, subglabri vel setosi. *Folia* opposita, lanceata vel oblongo-lanceata, ad basin subrotundata vel inaequaliter auriculata, ad apicem acuminata, ad margines minute denticulata vel serrata, supra glabra vel juvenilia minute brunneo-puberula, subtus ad nervos furfuracea vel parce setosa, 5-7 nervia, chartacea vel membranacea, petiolata vel subsessilia. *Inflorescentia* terminalis vel axillaris, glabra vel parce furfuracea ; flores in paniculas terminales vel cymas laterales multifloras vel paucifloras dispositi. *Bracteae* parvae, subulatae. *Calycis tubus* campanulatus, limbo obscure 4-lobato vel subtruncato. *Petala* 4, ovata vel ovato-oblonga. *Stamina* 8, aequalia vel subaequalia ; antherae linearifalcatae vel subulatae, breves vel elongatae, 1-porosae, connectivo ad basin vix producto, antice 2-auriculato et postice calcarato. *Ovarium* calycis tubo fixum per septa transversa 8, ' loculis 8 ' usque ad dimidium vel basin descendentibus. *Stylus* filiformis, glaber, stigmate punctiformi. *Bacca* subglobosa, glabra vel parce furfuracea. *Semina* plura, ovoidea vel subcuneata.

SPECIES TYPICA SEQUENS.

Erect shrub. *Branches* subterete or angular or subquadrangular, subglabrous or hairy. *Leaves* opposite, lance-shaped or oblong-lanceate, base subrotundate or unequally auriculate, apex acuminate, margin minutely denticulate or serrate, upper surface glabrous and when young minutely brownish puberulous, under surface along the nerves furfuraceous or sparsely setose, 5-7 nerved, chartaceous or membranaceous, petiolate or subsessile. *Inflorescence* terminal or axillary, glabrous or sparsely furfuraceous ; flowers in terminal panicles or lateral cymes, few or many flowered. *Bracts* small, subulate. *Calyx tube* campanulate, limb obscurely 4-lobed or subtruncate. *Petals* 4, ovate or ovate-oblong. *Stamens* 8, equal or subequal, anther linear-falcate or subulate, 1-porose, connective basally scarcely produced, dorsally calcarate and ventrally 2-auriculate. *Ovary* adherent to the calyx tube by 8 septa, extra-ovarial chambers 8, all descending to the middle or to the base of the ovary. *Style* filiform, glabrous, stigma punctiform. *Berry* subglobose, glabrous or sparsely furfuraceous. *Seeds* numerous, ovoid or subcuneate.

TYPE SPECIES : *Pseudodissochaeta assamica* (C.B.Cl.) Nayar.

The genus *Pseudodissochaeta* is proposed for the homogeneous group of species i.e. *P. assamica* (C.B.Cl.) Nayar, *P. subsessilis* (Craib) Nayar, *P. lanceata* Nayar and *P. septentrionalis* (W. W. Smith) Nayar. They are erect shrubs belonging to the tribe Dissochaeteae having eight equal or subequal stamens, hardly produced connectives which are dorsally calcarate and ventrally biauriculate, and having eight extra-ovarial




Map. Distribution of genus *Pseudodissochaeta* Nayar.

chambers descending to the middle or to the base of the ovary. Whereas the allied genus *Dissochaeta* Bl. are climbers having 4 equal, or 8 equal or unequal stamens which are dorsally calcarate and ventrally bisetose.

*Distribution :* North-east India, Upper Burma, South China, North Thailand, Laos, N. Vietnam and Hainan. (Map)

KEY TO THE SPECIES OF *Pseudodissochaeta*

1. Inflorescence in terminal branched many-flowered panicles ; leaves lanceate or oblong-lanceate, 10-20 × 2·5-6·5 cm.

    2. Connective not produced, branches quadrangular, calyx tube ribbed :

        3. Anther 5·5-6 mm. long ; flowers 6·5-8 × 3-3·5 mm. ; leaves 5-7 nerved, cross-venules distinct and close, leaf mainly glabrous, nerves on the under surface sparsely setose, leaves shortly petioled, petiole not more than 5 mm. long.......................... *P. assamica*

        3. Anther 2·5-3 mm. long ; flowers 4·5 × 2·5 mm. ; leaves 3-5 nerved, cross-venules distinct and distant, leaf mainly glabrous, nerves on the under surface softly pubescent, leaves subsessile, petiole not more than 3 mm. long.......................... *P. subsessilis*

    2. Connective shortly produced, 0·5 mm. long, branches subterete, calyx tube not ribbed, leaf distinctly petiolate, petiole 8-10 mm. long. . *P. lanceata*

1. Inflorescence in terminal and axillary few-flowered cymes, leaf ovate-lanceate or elliptic-lanceate, 6·5-8 × 2·5-3·5 cm.................. *P. septentrionalis*

DESCRIPTION OF SPECIES

1. **Pseudodissochaeta assamica** (C.B.Cl.) Nayar comb. nov. (Text-fig. 1.) *Anplectrum assamicum* C.B.Cl. in Hook. f. Fl. Brit. Ind. 2: 546, 1879 ; C. B. Clarke in Journ. Linn. Soc. Bot. 25 : 23, 1889 ; Kanj. & Das, Fl. Assam 2 : 303, 1938. Type : India, *C. B. Clarke* 42323 (Holotype K, isotypes K, E, BM, CAL). *Diplectria assamica* (C.B.Cl.) O. Kuntze, Revis. Gen. Pant 1 : 246, 1891.

*Distribution :* North-east India and North Burma.

INDIA. Assam : Muneypore, alt. 255 m., 30 Nov. 1885, *C. B. Clarke* 42323 (K, E, BM, CAL) ; Siboaga Dist., Desai Reserve, alt. 350 m., 24 Dec. 1912, *Kanjilal* 2026 (CAL) ; Khasi hills, *Herb. Kurz s.n.* (L) ; Margodda, *G. Watt* 11906 (E) ; Akha hills, Jan. 1890, *Dr. King's Collector* 71 (CAL) ; Upper Dihing Reserves, 8 Jul. 1959, *Panigrahi* 18812 (ASSAM) ; Naga hills, *Griffith* [Kew Dist. No. 2285 (K)] ; sine loc. *Herb. Nuttal* (K). BHUTAN : *Herb. Griffith* 2285 (CAL) ; ibid. *Herb. Griffith* 2018 (K, BM) ; Dupha hills, 11 Dec. 1874, *Lister* 71 (CAL) ; Digboi, Mar. 1935,

*Mrs. D. E. Bernard* M.D. 36 (BM). BURMA. Upper Burma: Nam Tamai Valley, alt. 1000 m. 27 Aug. 1938, *R. Kaulback* 95 (BM); valley of the Mali Hka, alt. 333 m.-1666 m., 17 Aug. 1937,

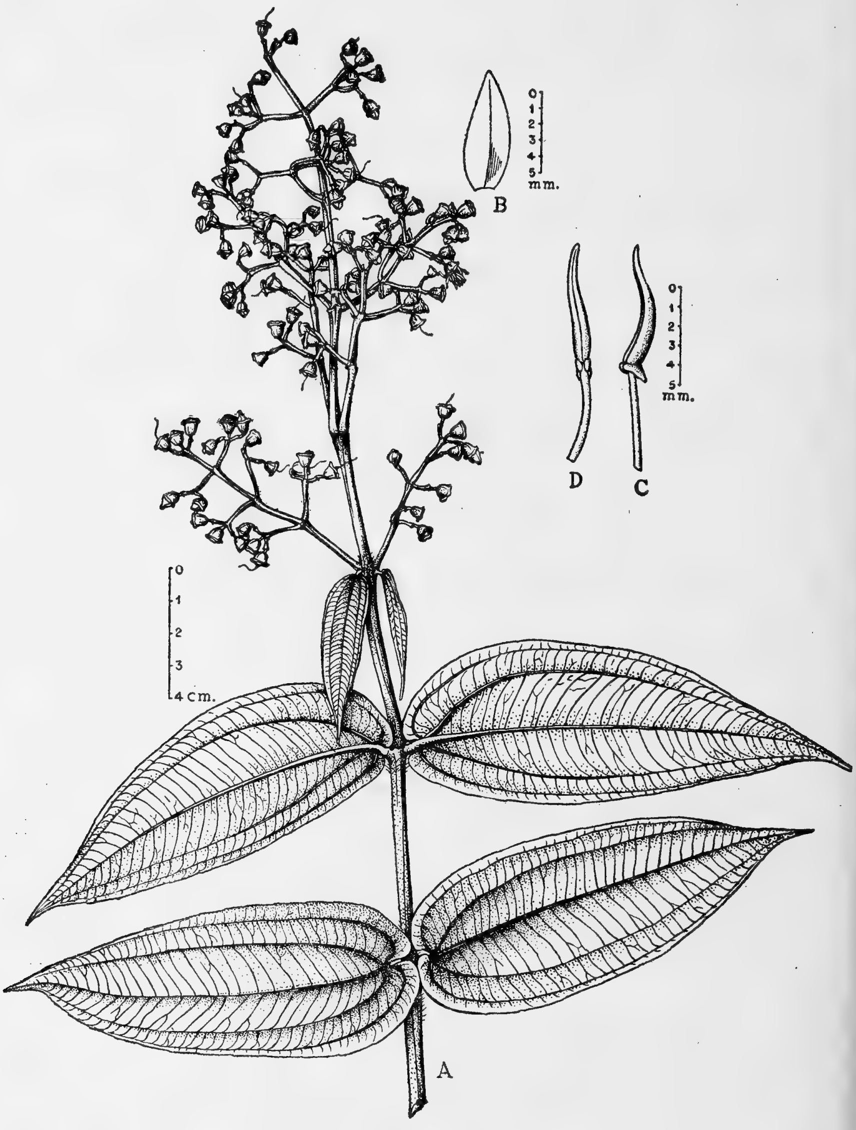



Fig. 1. *Pseudodissochaeta assamica* (C.B.Cl.) Nayar.
A. Habit. B. Petal. C. Stamen—side view. D. Stamen-ventral view.

*Kingdon-Ward* 12818 (BM); Kachin State, Hpuginhku, path side of Hpuginhku River, Sumprabum sub. div., alt. 1666-2000 m., 31 Dec. 1961, *J. Keenan, U Tan Aung, & W. Tha Hla* 3110 (K); Kajen hap, alt. 1000 m., Feb. 1912, *S. M. Toppin* 6199 (CAL).

In 1879 C. B. Clarke (in Hook. f. Fl. Brit. Ind. 2 : 546, 1879) described the species *Anplectrum assamicum* and assigned it to the list of doubtful species. However, in 1889 C. B. Clarke (in Journ. Linn. Soc. 25 : 23, 1889) emended the description and remarked as follows : 'I described imperfectly this plant in Hook. f. Fl. Brit. India ii p. 546 from Griffith's Kew Distribution No. 2285 which has no flowers. As the genera *Anplectrum* and *Dissochaeta* are diagnosed by the appendages at the base of the anthers I placed the plant in *Anplectrum* with doubt. But since I have seen the plant in full flower alive the doubt is rather increased ; for it will not go either into *Anplectrum* or *Dissochaeta* unless the characters of one of these genera be widened.' It is seen that the generic limits of the two genera have not been widened but instead appropriately reduced on the basis of the depth of the extra-ovarial chambers and on the nature of the stamens and staminal appendages. On this basis Bakhuizen van den Brink jr. (in Meded. Bot. Mus. & Herb. Rijks. Univ. Utrecht 91 : 41,1943) separated the genera *Diplectria* Reichenb. and *Neodissochaeta* Bakh. f. from the genus *Dissochaeta* Bl. *Anplectrum assamicum* differs from the genus *Anplectrum* A. Gray (*Backeria* Bakh. f.) in the nature of the extra-ovarial chambers and the stamens. In *Backeria* the extra-ovarial chambers are confined to the upper one-fourth of the ovary and the four fertile anthers are ovoid and inappendiculate. While in this taxon the extra-ovarial chambers descend to the base of the ovary and the stamens are fertile and linear-falcate and the connective dorsally ends in an appendage and ventrally ends in two auricles. In the nature of the extra-ovarial chambers this taxon is allied to *Dissochaeta* Bl., but differs in the nature of staminal appendages.

2. **Pseudodissochaeta subsessilis** (Craib) Nayar comb. nov. (Text-fig. 2.) *Allomorphia subsessilis* Craib in Kew Bull. 1913 : 69, 1913 ; *Idem*, Fl. Siam Enum. 1 : 686, 1931. Type : Siam, *Kerr* 2427 (Holotype K, isotypes BM, E)

*Small tree*, about 4·5 m. high. *Branches* quadrangular, nodes, leaf-axils and petioles pilose pubescent. *Leaves* opposite, subsessile, 14-18·5×3-4·2 cm., oblong-lanceate or lanceate, base unequally auriculate, apex acuminate, margin minutely denticulate, upper surface minutely brownish puberulous when young, glabrous later on, lower surface mainly glabrous, nerves on the lower surface softly brownish pubescent, 5-nerved, cross-venules distinct, chartaceous ; petiole 1-2 mm. long. *Inflorescence* paniculate, terminal, 18-28 cm. long, peduncle quadrangular, sparsely brownish pubescent ; flowers 4-merous, pedicel subangular, 0·8-1 mm. long, softly brownish pubescent ; bracteole 1-2 mm. long. *Calyx tube* campanulate, 3-3·5 mm. long, glabrate, 8-ribbed, shortly 4-dentate. *Petals* 4, 2·5-3×3 mm. *Stamens* 8, subequal, fila-

ment 2 mm. long, anther 2·5-3 mm. long, connective not produced, dorsally ends in a thick short appendage 0·4 mm. long, ventrally ends in

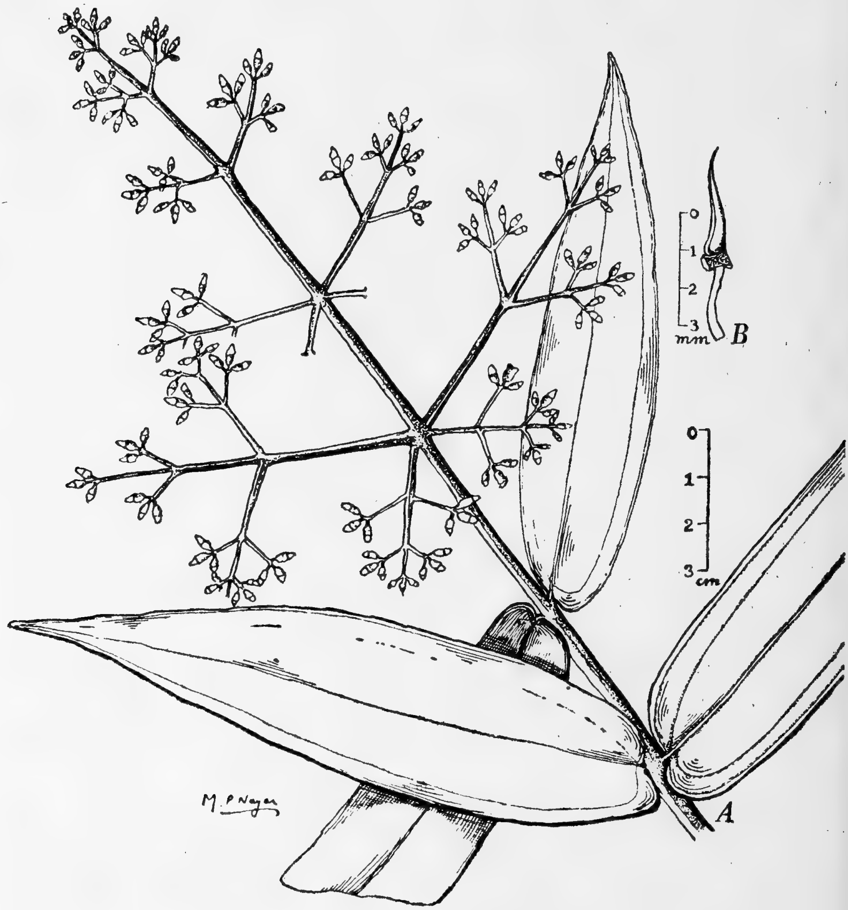



Fig. 2. *Pseudodissochaeta subsessilis* (Craib) Nayar.
A. Habit. B. Stamen—side view.

two auricles 0·3 mm. long. *Ovary* concrescent with the calyx tube by 8 septa, extra-ovarial chambers 8, all descending to the middle of the ovary. *Style* 5-7 mm. long, filiform, glabrous, stigma hardly conspicuous. *Berry* subglobose, 6×5 mm., glabrous. *Seeds* cuneate, 0·5 mm. long, numerous.

*Distribution :* North Thailand and Laos.

THAILAND. Maharat : Doi Wao, alt. 300-900 m., *Kerr* 2427 (K, E, BM) ; Doi Tiv (Nam), alt. 300 m., *Kerr* 5042 (BM, K) ; Dai pha Ngua, near Ban Pa Kuei, alt. 1030 m., *Garrett* 134 (K, BM) ;

Nan nam Muk, alt. 320 m., *Winit* 1768 (K); Lampang ni Katrid, *Winit* 1895 (K).

LAOS. Wiengeham, Barikhane, alt. 200 m., 28 Mar. 1932, *Kerr* 20779 (K, BM); 50 miles north of Vientiane, alt. 650 m., Nov. 1956, *L. G. Holliday* D. 11 (BM).

Craib established the species *Allomorphia subsessilis* on the basis of specimen *Kerr* 2427. The genus *Allomorphia* Bl. comes under the tribe *Oxysporeae* characterised by its capsular fruits. *Kerr* 2427 are without fruits though they are otherwise good specimens. While studying the herbarium sheets of *Allomorphia subsessilis* Craib at Kew, it was noted that the specimen *Winit* 1768 has well developed baccate fruits; whereas the genus *Allomorphia* has capsular fruits. However, Craib (in Fl. Siam Enum. 1 : 686, 1931) assigned the specimen *Winit* 1768 to *A. subsessilis* and it is presumed that he might have overlooked the presence of baccate fruits. *A. subsessilis* Craib is transferred to the newly proposed genus *Pseudodissochaeta* because of its baccate fruits, characteristic stamens, the degree of concrescence of the ovary with the calyx tube and the nature of its habit.

3. **Pseudodissochaeta lanceata** sp.nov. (Text fig. 3).

Arcte affinis *P. assamicae* (C.B.Cl.) Nayar, sed ramis subteretibus, petiolis longioribus, calycis tubo haud costato, connectivo 0·5 mm. longo differt.

*Frutex. Rami* juveniles subquadrangulares, subglabri, adulti teretes. *Folia* lanceata, 12-20×3-6·5 cm., rotundata vel obtusa ad basin, acuminata ad apicem, ad margines serrata, glabra, 5-nervia, venulis transversis haud conspicuis, membranacea; petioli 8-10 mm. longi. *Inflorescentia* paniculata, 25-35 cm. longa, sparse puberula, pedunculi angulares, compressiusculi, puberuli; flores tetrameri; bracteae 0·8 mm. longae, parvae; pedicelli 3-4 mm. longi, puberuli. *Calycis tubus* campanulatus, 5-5·5 mm. longus, sparse puberulus, limbo subtruncato. *Petala* 4, ovato-oblonga, 6-7×3 mm., apice obtusa, alba (teste collectore). *Stamina* 8, aequalia, filamentis 4·5-5 mm. longis, antheris lanceato-falcatis, 6-7 mm. longis, rostratis, 1-poris, connectivo 0·5 mm. longo, dorso in calcar 0·8-1 mm. longum producto, in parte ventrali in auriculas duas 0·8 mm. longas exeunte. *Ovarium* calycis tubo fixum per septa transversa 8, loculi 8, usque ad basin ovarii producti. *Stylus* filiformis, 9-10·5 mm. longus, glaber, stigmate punctiformi. *Fructus* ignotus.

*Typus*: Hainan, *Hong. Herb. No.* 406 (K).

*Shrub. Branches* terete, when young subquadrangular and subglabrous. *Leaves* lanceate, 12-20×3-6·5 cm., base rounded or obtuse, apex acuminate, margin serrate, glabrous, 5-nerved, transverse venules not conspicuous, membranaceous; petiole 8-10 mm. long. *Inflores-*

*cence* paniculate, 25-35 cm. long, sparsely puberulous, peduncle angular and somewhat compressed, puberulous; flowers 4-merous; bracts

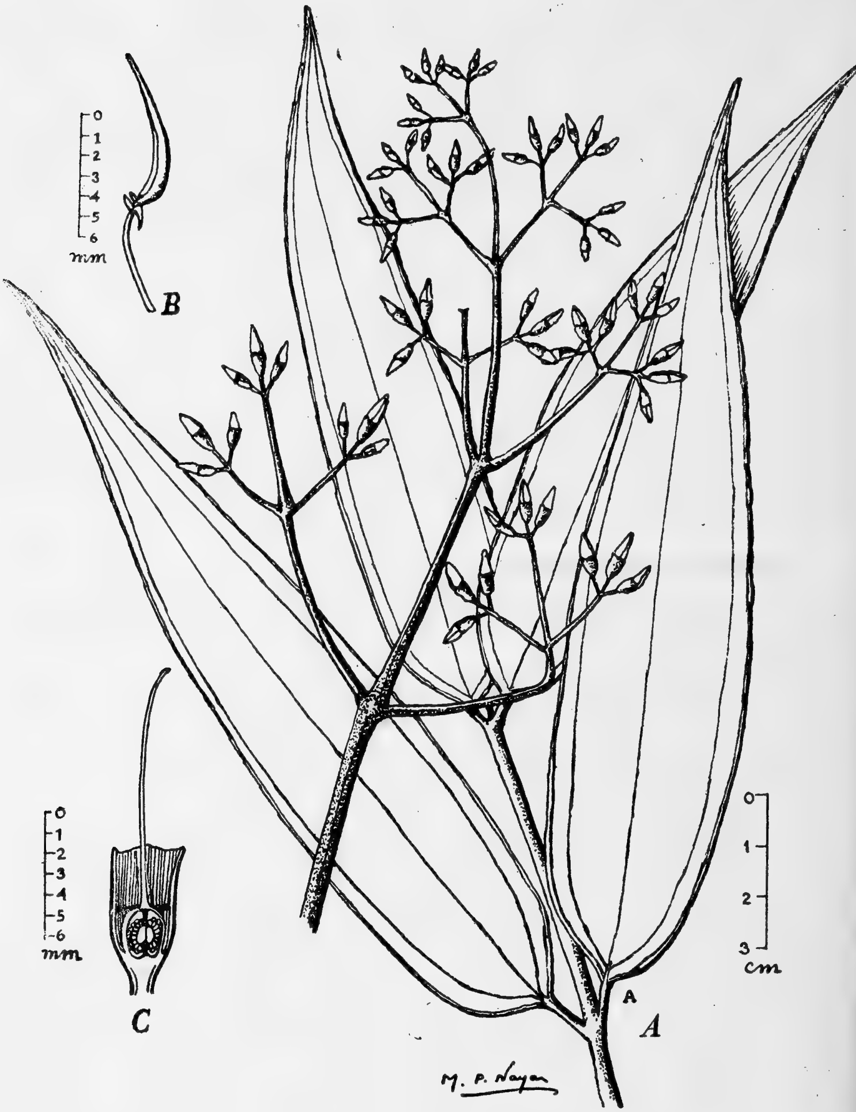



Fig. 3. *Pseudodissochaeta lanceata* sp. nov.
A. Habit. B. Stamen—side view. C. L. S. of Calyx tube.

0·8 mm. long, small; pedicel 3-4 mm. long, puberulous. Calyx tube campanulate, 5-5·5 mm. long, sparsely puberulous, limb subtruncate. *Petals* 4, ovate-oblong, 6-7×3 mm. apex obtuse, white (ex collector). *Stamens* 8, equal, filament 4·5-5 mm. long, anther lanceate-falcate, 6-7 mm. long, rostrate, 1-porose, connective 0·5 mm. long, dorsally

ends in 0·8-1 mm. long appendage and ventrally ends in two 0·8 mm. long auricles. *Ovary* concrescent with the calyx tube by 8 septa, extra-ovarial chambers 8, all descending to the base of the ovary. *Style* filiform, 9-10·5 mm. long, glabrous, stigma punctiform.

*Distribution :* Hainan.

HAINAN. Hong Ta, July 1893, *Hong. Herb. No.* 406 (Holotype K)

This species is closely allied to *P. assamica* (C.B.Cl.) Nayar, but differs in having subterete branches, unribbed calyx tube, comparatively long petioled leaves and shortly produced connective (0·5 mm. long). *P. lanceata* Nayar is endemic to the island of Hainan, whereas *P. assamica* occurs in N.E. India and Upper Burma.

Merril and Chun (in Sunyatsenia 5 : 144, 1940) appropriately suggested that ' *Anplectrum* sp.' enumerated in Lingnam Sc. Journ. 5 : 138, 1928 based on *Hong. Herb. No.* 406 is apparently a representative of some other genus.

4. **Pseudodissochaeta septentrionalis** (W. W. Smith) Nayar comb. nov. (Text-Fig. 4) *Oritrephes septentrionalis* W. W. Smith in Journ. As. Soc. Beng. N. S. 7 : 69, 1911 ; Type : Burma, *Macgregor* 751 (Lectotype E). *Medinilla caerulescens* Guillaum. in Lecomte, Fl. Indo-China 2 : 921, 1921 ; Craib, Fl. Siam. Enum. 1 : 699, 1931. *Medinilla caerulescens* Guillaum. var. *nuda* Craib, Fl. Siam. Enum. 1 : 699, 1931 ; Type : Siam, *Kerr* 5787 (Holotype K, isotype BM). *Anplectrum yunnanense* Kranzl. in Viert. Nat. Ges. Zurich 76 : 153, 1931; Type : Yunnan, China, *Henry* 11705 (Isotypes K, E). *Medinilla septentrionalis* (W. W. Smith) Li in Journ. Arn. Arb. 25 : 38, 1944.

*Shrub* about 3 m. in height. *Branches* terete, glabrous, sparsely puberulous at the nodes. *Leaves* ovate-lanceate, 6·5-8 cm. × 2·5-3·5 cm., base obtuse or subcuneate, apex acuminate, acumen 1·2-1·8 cm. long, margin distantly serrate, glabrous on the upper and lower surface, 5-nerved, 3 prominent nerves and 2 faint marginal nerves, membranaceous ; petiole 5-7 mm. long. *Inflorescence* in terminal or axillary cymes, 3-4·5 cm. long, main axis slightly compressed, glabrous excepting at the nodes ; bracts minute, 0·2 mm. long ; pedicel 1-2 cm. long. *Calyx tube* campanulate, 5-6 mm. long, sparsely ciliate, deciduous, bristles 1·5 mm. long, otherwise glabrous, 8-ribbed, limb undulate. *Petals* 4, oblong, 5-5·5 × 3·5-4 mm. *Stamens* 8, subequal, filament 6-6·5 mm. long, anther linear-falcate, 7-8 mm. long, apex acuminate-attenuate, 1-porose, connective shortly produced 0·4 mm. long, dorsally ends in a triangular appendage, 0·6 mm. long and ventrally ends in two small auricles, 0·5 mm. long. *Ovary* concrescent with the calyx tube by 8


Fig. 4. *Pseudodissochaeta septentrionalis* (W. W. Smith) Nayar.
A. Habit. B. Stamen—side view. C. L.S. of Calyx tube.

septa, extra-ovarial chambers 8, all descending to the base of the ovary. *Style* 9-11 mm. long, filiform, glabrous, stigma punctiform. *Berry* globose-ovoid, 6-7$\times$4-5 mm., glabrous. *Seeds* minute, 0·6 mm. long, numerous.

*Distribution :* Upper Burma, S. China, N. Thailand and N. Vietnam.

BURMA. S. Shanan, *Macgregor* 751 (E). CHINA. Yunnan : Szemao, alt. 1666 m., *Henry* 11705 (K, E) ; Szemao & Mengtze, alt. 1666 m., *Henry* 11705 A (K, E) ; ibid. alt. 1333 m., *Henry* 11705 B (K, E) ; ibid. *Henry* 11705 C (K, E, BM) ; hills around Lung fan, alt. 2000 m., *Forrest* 27163 (E, K) ; *s. l.* alt. 2000 m., Aug. 1885, *Forrest* 26642 (E). THAILAND : Rachasima : Korat, Kao Lem, alt. *c.* 1000 m., 11 Jan. 1925, *Kerr* 9932 (K, BM) ; ibid. *Put* 3569 (K) ; Udawan : Dan sai, Pu Lom lo, alt. *c.* 1200 m., *Kerr* 5787 (K, BM) ; Maharat : Nan Do Pu Ka, alt. *c.* 1300 m., 25 Feb. 1921, *Kerr* 4913 (K, BM) ; Chiengamai : Doi Nang ka, *Put* 3401 & 3761 (K). N. VIETNAM. Tonkin : Sai Wong Mo Shan, Long Wgong village, *Tsang* 30462 (K) ; ibid. Lung wan village, *Tsang* 30024 (K) ; ibid. near Chut Phai, *Tsang* 29118 & 29163 (K) ; Chuk Phai, *Tsang* 27021 (K) ; N.E. of Mon cay, Pac-sa and vicinity, *Tsang* 26929 (K).

W. W. Smith (1911) included *Oritrephes septentrionalis,* in *Oritrephes* Ridley, a Malayan genus of the tribe Oxysporeae characterised by their capsular fruits. The species has baccate fruits and should belong to the tribe Dissochaeteae. Guillaumin's (1921) *Medinilla caerulescens* was later found to be conspecific with Smith's *Oritrephes septentrionalis* and Kranzlin (1931) proposed a new binomial *Anplectrum yunnanense* for the same taxon. The fact that different botanists independently assigned the same taxon to the following genera i.e. *Oritrephes, Medinilla* and *Anplectrum,* indicates the difficulty in determining its taxonomic position. Though Li (in Journ. Arn. Arb. 25 : 38, 1944) followed Guillaumin in assigning this taxon to *Medinilla,* it is interesting to note his comments : ' it is somewhat anomalous in the genus.'

In the genus *Medinilla* the extra-ovarial chambers descend to the middle of the ovary, whereas in this taxon the extra-ovarial chambers descend to the middle or to the base of the ovary. However the nature of its habit, and its characteristic staminal appendages indicate that it should appropriately find its place in the new genus *Pseudodissochaeta* Nayar.

## Acknowledgements

I wish to express my gratitude to Sir George Taylor, Director, Royal Botanic Gardens, Kew, for all facilities during my stay at Kew from 1961-67. I am indebted to the authorities of the following Herbaria for their hospitality during my visits and for the loan of herbarium specimens: The Herbarium, Royal Botanic Gardens, Edinburgh; Rijksherbarium, Leiden; The British Museum (Nat. Hist.), London. My thanks are also due to the Director of the Botanical Survey of India, Rev. Fr. Dr. H. Santapau for his encouragement.

# Feeding habits of the fish *Megalops cyprinoides* Broussonet, in the Cooum backwaters, Madras

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(*With three text-figures*)

The feeding of the fish, *Megalops cyprinoides* seems to be concentrated on a few key species so that within the community only the populations of these species suffer predation. Changes in feeding succession in relation to size are related not only to food preferences but also to availability of food. Feeding intensity, as assessed from the stomach contents, was more or less uniform throughout the year. It varied between 0·7 and 0·8% body weight. Because of the uniform temperature conditions prevailing in the tropics, temperature effects on feeding intensity seems to be less pronounced. A single peak observed during the monsoon months is attributed to a greater abundance of food in the environment. In some months, the fish stops feeding during the day time and probably temperature fluctuations may have some bearing on the feeding periodicity.

## INTRODUCTION

It is well known that the fishes feed intensively during spring and summer in temperate waters (Allen 1940). This fact has been related to the abundance of food supply by Hardy *et al.* (1936) and later by Ricker (1937) to the combined effect of food supply and temperature. In tropical waters of India, however, temperature is uniformly higher than the maxima in higher latitudes and the seasonal differences are less marked; rather uniform organic productivity prevails throughout the year (Ramamoorthy 1953; Bogorov 1960). To what extent such relative uniformity in food supply and temperature conditions influence the intensity of feeding has received very little attention. The present paper reports on the feeding habits of a tropical fish, with special reference to the factors influencing the feeding intensity.

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## Material and Methods

*Megalops cyprinoides* Broussonet (Elopidae) was collected from the River Cooum, Madras, which is a shallow canal of 50 metre width and 2 metre depth, receiving in its course sewage effluents. It reaches the sea close to the University Laboratory. Most of the year it is separated from the sea by a sand bar. With the onset of monsoon, the water level rises and the sand bar breaks, thus allowing the stream to flow into the sea in late October or early November for a period of about 3 to 5 weeks. During the rest of the year the Cooum is more or less stagnant. For topographic and hydrographic details consult Ganapati (1964).

*M. cyprinoides* is distributed from Madagascar to the East Indies. The juvenile fishes migrate into the backwaters of the east coast of India, where they grow up to 300 to 400 gm. in weight but do not attain maturity in these waters of low salinity (Job & Chacko 1947), and are said to return to the sea. Larger fishes weighing 600 gm. or more, have not so far been observed in the backwaters. The fish is available in the Cooum backwaters in large numbers throughout the year.

The food and feeding habits of the fish were studied from July 1963 to June 1964 by analysing the stomach contents of 403 specimens measuring 4·3 cm. to 31·7 cm. in standard length. Specimens were collected in the early hours of the morning with a cast net operated from a catamaran which could catch about 30 to 40 individuals within an hour or so. The fishes were brought to the laboratory, weighed and volume of stomach contents in relation to the size of the fish was determined. The various food contents were then analysed qualitatively and quantitatively and the volume of different food fractions was measured by the displacement method (see Hynes 1950 ; Pillay 1951).

## Observations

Crustaceans, insects and fishes formed the major food items of the fish *M. cyprinoides.* The crustaceans included, copepods *Cyclops bicolor*, cladocerans, *Daphnia* sp. and the prawn, *Metapenaeus monoceros* and insects, corixid bugs, *Micronecta scutellaris* and *Notonecta* sp., aquatic beetles *Dysticus* sp., midge larvae and pupae of *Chironomus* sp., and nymphs of *Platycenemus* sp. Fish included the fry of *Chanos*, *Elops* and *Therapon* and the juveniles of *Mugil* and the adults of the genera *Barbus*, *Gambusia* and *Mystus*. Other items of minor importance were the eggs of crustaceans and rotifers and a number of species belonging to the genus *Brachionus*. Stray occurrences of megalopa larvae of brachyuran crabs and the malacostracans *Cirolina* and *Grandierrella* were also recorded, especially during the rainy season. Table 1 gives the

seasonal variations in the composition of different food fractions (Fig. 1). The year can be arbitrarily divided into three periods namely,

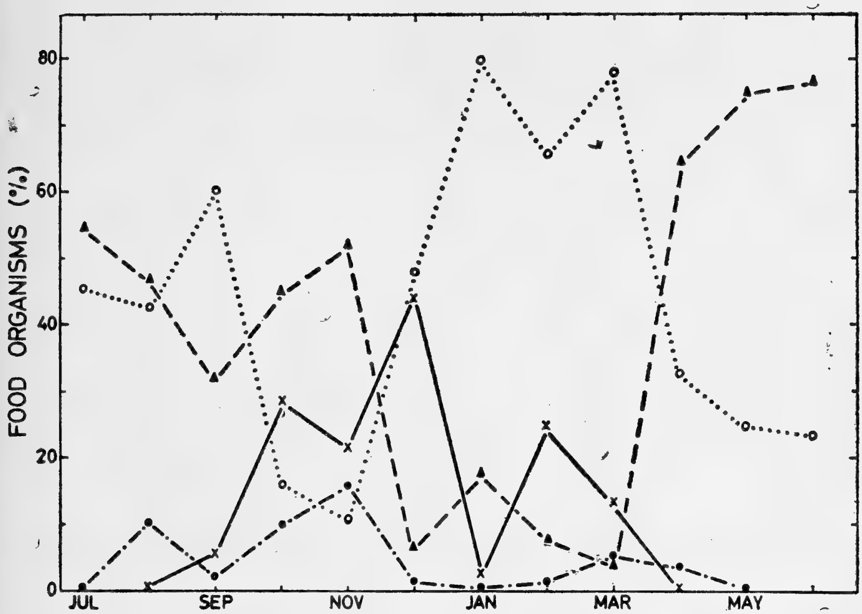


Fig. 1. Monthly variations in the food composition of *Megalops cyprinoides* collected from July '63 to June '64 in the Cooum backwaters, Madras.

Key : Δ — — Δ = Crustaceans ; o. . . .o = Insects
×——× = Fishes ; ●—o—o—o● = Miscellaneous

Rainy (August to November), Cold (December to March), and Hot (April to July) Seasons with temperature characteristics of 27°, 25°, and 30°C. respectively. The different food fractions characteristic of a period (expressed in % of total food) have been considered as basic, secondary and incidental food (Nikolsky 1963). It may be seen from Table 2 that intensive feeding at any given period centred around a few key species only. This observation conforms with those of Shorykin (1939) and Darnell (1961), who have shown that in a community only a few species suffer heavy losses from predatory fishes.

In the present investigation, only fishes measuring 4·5 to 31·7 cm. in length were available for study. A comparison of the food composition of different size groups indicates that there was no marked difference in the food preference in relation to size of the fish. The smallest *M. cyprinoides* found in the Cooum backwaters were 4·5 cm. in length ; these were feeding mainly on planktonic organisms and *Chironomus* and rarely on the fish *Gambusia*. A similar observation

has been reported in the case of larval and juvenile tarpon *Megalops atlantica* by Harrington & Harrington (1960).

TABLE 1

MONTHLY VARIATIONS IN THE PERCENTAGE COMPOSITION OF MAJOR FOOD ITEMS OF *Megalops cyprinoides* COLLECTED FROM THE COOUM BACKWATERS

| | Food | | | |
|---|---|---|---|---|
| Month & Year | Crustaceans (%) | Insects (%) | Fishes (%) | Miscellaneous (%) |
| July '63 | 54·64 | 45·36 | — | — |
| Aug. '63 | 46·90 | 43·00 | — | 10·10 |
| Sep. '63 | 31·94 | 60·24 | 5·77 | 2·24 |
| Oct. '63 | 45·18 | 16·12 | 28·61 | 10·08 |
| Nov. '63 | 51·76 | 10·60 | 21·98 | 15·66 |
| Dec. '63 | 6·43 | 48·11 | 43·92 | 1·54 |
| Jan. '64 | 17·40 | 79·80 | 2·80 | — |
| Feb. '64 | 7·82 | 66·08 | 24·80 | 1·30 |
| Mar. '64 | 3·93 | 79·80 | 13·41 | 2·80 |
| Apr. '64 | 64·31 | 32·45 | — | 3·24 |
| May '64 | 75·03 | 24·97 | — | — |
| June '64 | 76·67 | 23·33 | — | — |

TABLE 2

SEASONAL VARIATIONS IN THE FOOD COMPOSITION OF *Megalops cyprinoides*

| Period | Basic food (25 to 75% of total) | Secondary food (5 to 25% of total) | Incidental food (less than 5% of total) |
|---|---|---|---|
| Aug. to Nov. (Rainy Season Temp. 27°C.) | *Micronecta*, *Metapenaeus* | *Cyclops*, *Elops*, *Chanos*, *Therapon* | *Dysticus*, *Brachionus* |
| Dec. to Mar. (Cold Season Temp. 25°C.) | *Chironomus* larvae & pupae | *Gambusia*, *Barbus*, nymphs of *Platycenemus* | *Notonecta* |
| Apr. to July (Hot Season Temp. 30°C.) | *Cyclops* | *Micronecta*, Ostracods | *Brachionus* |

For a period of about seven weeks during the rainy season (from the middle of October till the early December), when the sand bar between the Cooum and the sea breaks, a large variety of larval and juvenile forms of marine animals migrate into the Cooum, thereby increasing the quantity and variety of food organisms available (Panikkar & Aiyar 1939). To ascertain if there was selective feeding among the different size groups on these food organisms, the data obtained for the

months of October, November, and December have been pooled together. Four size groups, with a size range of 4·3-9·9 cm., 10·0-14·9 cm., 15·0-24·9 cm., and 25·9-30·3 cm. were averaged and the mean sizes obtained were 8·3, 12·5, 17·0, and 27·7 cm. in length, respectively, (Table 3). It can be seen from Figure 2 that with an increase in size, there is a marked preference towards fish-food. Insects and crustaceans, which formed more than 35% each in the first and second size groups, are correspondingly reduced in the third and fourth size groups. Thus, with increasing size, the fish passes through the feeding succession : crustaceans → insects → fishes. Similar feeding succession has also been observed for carnivorous fishes like *Esox lucius* (Hunt & Carbine 1951). Difference in food preferences among the different size groups may be an adaptation for an effective utilization of the increased range of food supply (Nikolsky 1963).

The different food items of *M. cyprinoides* were arbitrarily divided into microfauna comprising planktonic organisms and macrofauna consisting of prawns, insects and fishes. There was a remarkable increase in the macrofauna components eaten during the period, September to March, accompanied by a corresponding decrease in microfauna (Table 4 ; Fig. 3). These changes can be attributed to the ease with which the prey can be captured. For instance, fully ripe females of *Mystus* and *Barbus* were often eaten in October and December, respectively, but were absent in the stomach in other months, although they were present in the Cooum. As the gonads ripen *Mystus* (Pandian in press) and *Barbus* females, become sluggish and are perhaps easily caught during October and December. The frequent occurrence of isopods and amphipods in the stomach of the fish only during November and December and not in other months, indicates that they move to the surface from the muddy bottom because of flooding.

Table 3

Food progression in different size groups of *Megalops cyprinoides* collected from October to December 1963 in the Cooum backwaters

| Size group (body length cm.) | Total examined | Crustaceans (%) | Insects (%) | Fishes (%) | Miscellaneous (%) |
|---|---|---|---|---|---|
| 8·3 | 10 | 52·23 | 11·57 | 18·10 | 17·10 |
| 12·5 | 32 | 42·92 | 36·25 | 11·30 | 9·53 |
| 17·0 | 75 | 33·31 | 21·59 | 40·54 | 4·56 |
| 27·7 | 4 | 34·80 | 11·45 | 53·75 | — |

During the month of May, 14 individuals collected had empty stomachs, but their intestines were more or less gorged with food. The

absence of food in the stomach of the fishes collected during this period is probably due to their feeding at night, and the food having passed

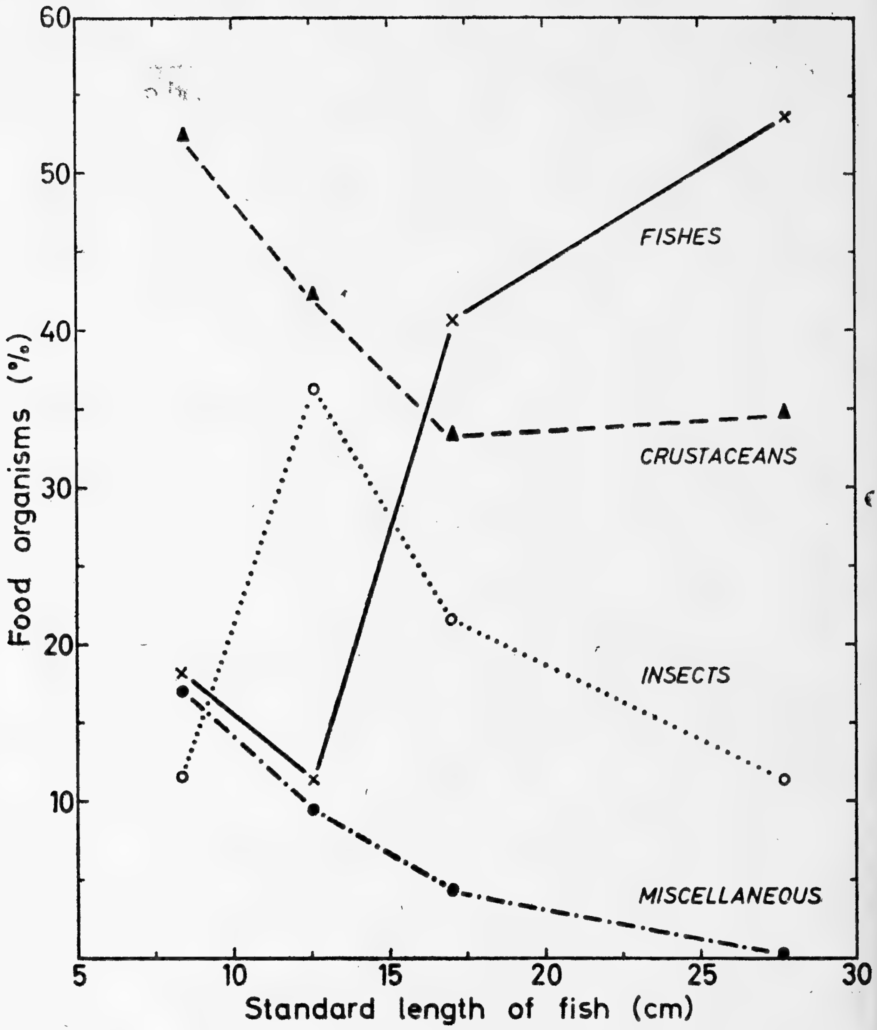


Fig. 2. Food progression in different size groups of *Megalops cyprinoides* collected from October to December 1963 in the Cooum backwaters, Madras.

into the intestine at the time of collection (6 a.m.). This assumption is supported by the observation that collections made during the night (11 p.m.) during this period showed stomachs full of copepods, ostracods, corixid bugs etc. Similar results were recorded until the end of June. The plankton collection made in the area during the day revealed that all the items consumed by the fish at night were present in the plankton,

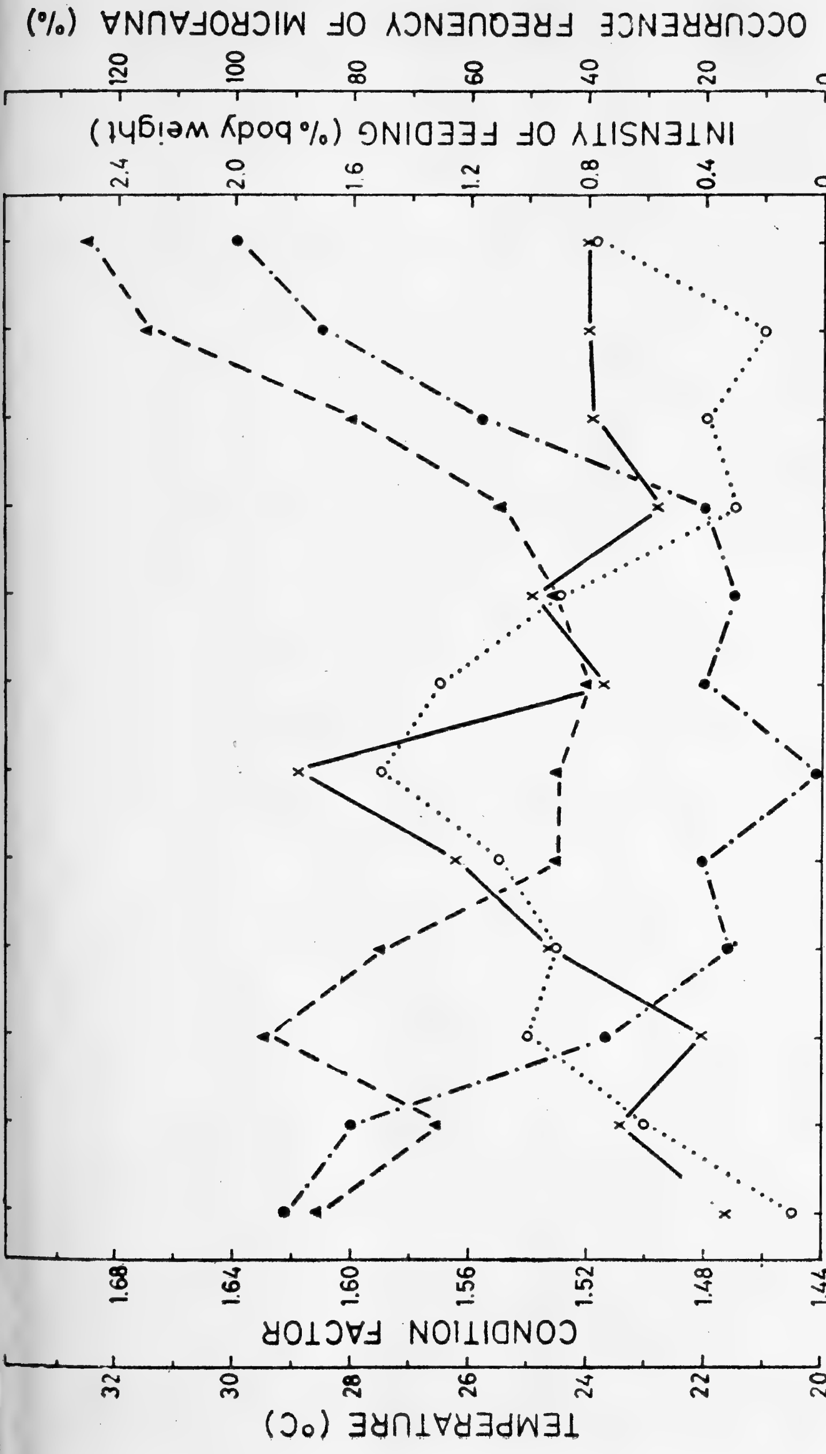


Fig. 3. Monthly variations in the intensity of feeding during the period July 1963 to June 1964. (× ——— ×), occurrence frequency of microfauna (● — o — o ●). and condition factor (o . . . . . o) of the fish *Megalops cyprinoides* and surface temperature (Δ — — — Δ) of the Cooum back waters, Madras.

Therefore, it may be inferred that the fish did not feed during the day not because of the non-availability of food, but for some other reasons, which are not clear owing to lack of data on turbidity of water, diurnal migrations of planktonic organisms and other factors. In Canadian waters, cessation of feeding due to higher temperature during the day and resumption of feeding during the night by the juveniles of *Salmo salar* has been reported by Hoar (1942).

The amount of food consumed by *M. cyprinoides* varied during the different months of the year (Table 4; Fig. 3). Feeding intensity, was low in July (0·318% body weight), and increased steadily throughout the rainy season reaching a maximum of 1·784% body weight in December. It declined (0·742% body weight) in January, but again increased to 0·991% body weight in February and remained at about 0·8% body weight throughout the summer months. The fish fed intensively from October to December. In other months, the intensity of feeding was more or less uniform; the variations being within a range of 0·7 to 0·8% body weight.

TABLE 4

MONTHLY VARIATIONS IN THE AMOUNT OF FOOD CONSUMED, OCCURRENCE FREQUENCY OF MICROFAUNA, CONDITION FACTOR OF *Megalops cyprinoides* AND CHANGES IN SURFACE TEMPERATURE OF THE COOUM BACKWATERS

| Month & Year | Total examined | Food consumed (% body wt.) | Occurrence frequency of microfauna (%) | Condition factor (K) | Temperature of the Cooum (°C.) |
|---|---|---|---|---|---|
| July '63 | 11 | 0·318 | 90·90 | 1·45±0·15 | 28·5 |
| Aug. '63 | 39 | 0·683 | 79·61 | 1·50±0·10 | 26·5 |
| Sept. '63 | 35 | 0·392 | 37·15 | 1·54±0·14 | 29·5 |
| Oct. '63 | 38 | 0·908 | 15·79 | 1·53±0·15 | 27·5 |
| Nov. '63 | 39 | 1·246 | 20·51 | 1·55±0·19 | 24·5 |
| Dec. '63 | 52 | 1·784 | 0·00 | 1·59±0·17 | 24·5 |
| Jan. '64 | 44 | 0·742 | 20·45 | 1·57±0·14 | 24·0 |
| Feb. '64 | 39 | 0·991 | 15·38 | 1·53±0·15 | 24·5 |
| Mar. '64 | 30 | 0·558 | 20·00 | 1·47±0·07 | 25·5 |
| Apr. '64 | 34 | 0·780 | 58·00 | 1·48±0.04 | 28·0 |
| May '64 | 22 | 0·799 | 85·00 | 1·46±0·08 | 31·5 |
| June '64 | 20 | 0·785 | 100·00 | 1·52±0·08 | 32·5 |

Intensive feeding, as during the monsoon period from October to December may be accompanied by a change in growth of the fish. The mean condition factor of *M. cyprinoides* as seen from Table 4, steadily increased throughout the rainy season, reaching a maximum of 1·59 in December. It then declined gradually during the cold season and remained more or less low during the hot season. Further, Figure 3 shows that the trends obtained for the condition factor and the feeding

intensity are almost parallel to each other, indicating the effect of fluctuations in the food supply, not only on the consumption of food but also its resultant effect on the growth of the fish.

During the period of rapid growth, fishes and insects formed a major proportion of the diet of *M. cyprinoides*. Hunt & Carbine (1951) showed that an acceleration of growth of the fish *Esox lucius* is associated with its change over to fish diet. The selection of larger food organism by *M. cyprinoides* during the period October to March (Table 4) is significant as it helps the fish in cutting down the energy expenditure by capturing fewer prey (see also Allen 1935 ; Nikolsky 1963). During this period the condition factor of the fish was more than 1·5 (Fig. 3). Moreover, Pandian (1967b) showed that the conversion rates of protein and total food in *M. cyprinoides* is faster in individuals fed on *Gambusia affinis* than those fed on *Metapenaeus monoceros*. In the present study, the growth rate of *M. cyprinoides*, as indicated by the condition factor, is faster during the rainy season when *Gambusia* and other small fishes formed the main food than during the pre-monsoon period when *Metapenaeus* and other crustaceans were taken. During summer, the fish feeds less and in most cases ostracods formed an important food source. They were, however, not easily digested, since most of the ostracods observed from the rectal content were intact with bivalved carapace. Gerking (1962) reported that ostracods were found similarly in the lower part of the intestine of *Lepomis macrochirus*. Apparently, ostracods so common in the stomach of *M. cyprinoides* during the summer months have little food value to the fish, and this may account for the relatively lower value of the condition factor during these months.

## Discussion

It is seen that the quantity of food consumed by *M. cyprinoides* was more or less uniform except for a marked increase during the period October to December. Although previous studies, Job (1940), Vijayaraghavan (1950, 1951a, b, 1953) and Kuthalingam (1955a, b, 1956a, b) have been limited to the species composition and to the seasonal changes of the diet of a number of coastal water fishes of Madras, their data indicates a similar feature as has been observed in the present study. A point to be noted is that the intensity of feeding, observed in *M. cyprinoides* is not as pronounced as one finds in temperate fishes. It is known that the intensity of feeding is influenced by the food supply, temperature, and reproductive cycle of the fish (Ricker 1946). In the present study, feeding habits refer to immature forms since mature *M. cyprinoides* do not occur in the brackish waters of the Cooum. Therefore, nothing can be said of the influence of breeding cycle on the feeding rhythm. The surface water temperature of the Cooum is quite high and

varies from 24° to 32°C. seasonally. Whereas, in temperate waters very low winter temperature may reduce or even stop feeding in fishes (Moffett & Hunt 1943 ; Ricker 1946), tropical fishes like *M. cyprinoides* enjoy relatively constant and warm temperature conditions and it appears that temperature has no bearing on the intensity of feeding in *M. cyprinoides*. Therefore, increase in feeding intensity observed from October to December in the fish is attributable to the changes in food supply in the habitat, because of the breaking of the sand bar at the mouth of the river.

*M. cyprinoides* of 1 gm. weight when fed on prawn *Metapenaeus monoceros* in the laboratory consumed 9·2% body weight/day and with increasing size of the fish, the feeding rate decreased to 1·8% body weight/day in 150 gm. individual, (Pandian 1967a). Considering this fact, the quantity of food (0·8 to 1.8% body weight) consumed by the fish collected in the Cooum is low. One of the possibilities seems to be that fishes feed more than once in the natural habitat. In fact it has been recently emphasized that intensity of feeding must be based not only on the quantity of food found in the stomach at the time of observation but also on the rate of digestion (Bajkov 1935) and on the frequency of feeding (Darnell & Meierotto 1962). In view of the difficulties in making continuous observations over a period to count the frequency and the limitations encountered in applying the data obtained for digestion rates in the laboratory to the fishes collected in the Cooum, the present study has been confined to the observations on the stomach contents alone. Finally, it can be seen that it is more important to study the efficiency and rate at which the food ingested is converted for growth in natural habitat by the fish than to consider the various aspects influencing the frequency of feeding and digestion rate. Allen (1940, 1941, 1951) and Benson (1953) have combined studies, such as those mentioned above, in relation to the condition factor. The changes observed for feeding intensity and those of condition factor of *M. cyprinoides* were parallel to each other. It is assumed that the results obtained for intensity of feeding based on the stomach contents are reasonably reliable and that additional effects due to changes in digestion rate and frequency of feeding would not alter the main trends observed.

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# Eco-Toxicology and Control of Indian Desert Gerbil, *Meriones hurrianae* (Jerdon)

## V. Food preference in the Field during Monsoon

BY

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Food preference of the Indian Desert Gerbil, *Meriones hurrianae* (Jerdon) during monsoon is described by identifying the unconsumed plant species lying near their burrow openings and from field observations with binoculars. A comparison of the occurrence of unconsumed plant species with that in the surrounding plant communities revealed that the Desert Gerbils chiefly feed on grasses in the monsoon season. Economic losses by the Desert Gerbil are discussed.

### INTRODUCTION

An earlier study of the stomach contents of the Indian Desert Gerbil, *Meriones hurrianae* (Jerdon) had revealed that normally their food consists of seeds but during the rainy season they thrive more on shoots, leaves and flowers of plants that are readily available (Prakash 1962). Only a few plant species could, however, be identified from the stomach contents since they were thoroughly masticated. Recently, during field observations, it was noticed that while consuming plants, the rodents leave identifiable portions near their burrow openings during the monsoon season, the main flowering season for herbs in the desert. This study is aimed at finding the preference for various herbs and to estimate their loss under field conditions.

### METHODS

Plant remains were identified and the number occurring near each burrow opening was recorded. In one plant community observations were taken around 20 to 30 burrow openings. The composition of the vegetation was studied by line intercept method and frequency of occurrence of each species was compared with the frequency of occurrence of that species found unconsumed near gerbil burrow openings. If the latter

was more than twice its occurrence in the surrounding vegetational community, that species was regarded as 'most preferred'; if less than twice 'preferred', if less than its occurrence in the community but not less than 50 per cent 'less preferred', and if less than 50 per cent then 'not preferred'. Each of the above four palatability class was awarded the numerical scores of 4, 3, 2 and 1, respectively. To find out the palatability index of various food species the numerical scores denoting the various palatability classes were added for species occurring in more than two communities and an average was found out.

Observations were also made with a 10×40 binoculars on gerbils feeding on various identified plant species.

All these observations were made during the monsoon season at Maulasar in a fenced area of 72 hectares. This area lies in a tract with an average annual rainfall of 400 mm., in the Nagaur District of Western Rajasthan.

## Observations and Discussion

### I. Observations on unconsumed plant species lying near Desert Gerbil burrow openings

The observations were taken in four plant communities found in the area:

(a) *Cenchrus ciliaris—Cyperus arenarius—Eleusine compressa—Phaseolus trilobus* community

This community was situated on a low lying sandy plain and the species comprising this community had a frequency of 75 per cent in the transects. The other species in this community having a frequency of 50 per cent were *Justicia vahlii, Digitaria adscendens, Tephrosia purpurea,* and *Boerhavia diffusa. Cenchrus ciliaris,* although forming 14·0 per cent of the vegetation in this community, constituted 69·2 per cent of plant species found unconsumed near burrow openings (Table 1). It was the most preferred species. *Cyperus arenarius* and *Aristida adscensionis* although having a low per cent of incidence in nature (0·66 and 2·0 per cent only) yet formed 7·7 per cent of the gerbil food indicating a high preference for these. *Eleusine compressa* on the other hand formed 10·6 per cent of the community and formed only 7·7 per cent of the rodent diet. It is worth noting that the plant *Phaseolus triolobus* and those having 50 per cent frequency were completely absent from the gerbil menu indicating that they are unpalatable to gerbils. This may also be due to the higher availability of *Cenchrus ciliaris* which forms the majority of the gerbil food in this plant community. 92·2 per cent of the food species were grasses (Poaceae).

(b) *Digitaria adscendens—Perotis hordeiformis—Brachiaria ramosa—Eragrostis ciliaris* community.

The community was found on a stabilised sand dune. The four species forming this community had a frequency of 83·3 per cent and the

TABLE 1

PER CENT OCCURRENCE OF UNCONSUMED PLANT SPECIES NEAR GERBIL BURROW OPENINGS AND IN NATURE, AND THEIR PALATABILITY CLASSES IN THE PLANT COMMUNITY(a)

| Plant species | Per cent occurrence | | Palatability classes |
|---|---|---|---|
| | Unconsumed plant species near burrow openings | in nature | |
| *Cenchrus ciliaris* | 69·2 | 14·0 | most preferred |
| *Eleusine compressa* | 7·7 | 10·6 | less preferred |
| *Aristida adscensionis* | 7·7 | 2·0 | most preferred |
| *Cyperus arenarius* | 7·7 | 0·66 | most preferred |
| *Digitaria adscendens* | 3·8 | 2·6 | preferred |
| *Eragrostis ciliaris* | 3·8 | 0·66 | most preferred |

others having a frequency of 66·6 per cent were : *Tribulus terrestris* and *Justicia vahlii* ; and those having a frequency of 50 per cent were : *Cyperus*

TABLE 2

PER CENT OCCURRENCE OF UNCONSUMED PLANT SPECIES NEAR GERBIL BURROW OPENINGS AND IN NATURE, AND THEIR PALATABILITY CLASSES IN THE PLANT COMMUNITY(b)

| Plant species | Per cent occurrence | | Palatability classes |
|---|---|---|---|
| | Unconsumed plant species near burrow openings | in nature | |
| *Digitaria adscendens* | 21·3 | 17·3 | less preferred |
| *Cenchrus ciliaris* | 18·6 | 1·8 | most preferred |
| *Brachiaria ramosa* | 8·0 | 9·5 | less preferred |
| *Eragrostis ciliaris* | 8·0 | 6·5 | preferred |
| *Aristida adscensionis* | 8·0 | 6·0 | preferred |
| *Dactyloctenium aegyptium* | 8·0 | 3·5 | most preferred |
| *Eragrostis cilianensis* | 6·6 | 1·8 | most preferred |
| *Cenchrus biflorus* | 5·3 | 0·6 | most preferred |
| *Tribulus terrestris* | 2.6 | 12·0 | not preferred |
| *Tragus biflorus* | 2.6 | 3·0 | less preferred |
| *Glinus hirta* | 2·6 | 1·8 | preferred |
| *Cucumis callosus* | 2·6 | 0·6 | most preferred |
| *Perotis hordeiformis* | 1·3 | 10·7 | not preferred |
| *Cyperus arenarius* | 1·3 | 3·0 | not preferred |
| *Boerhavia diffusa* | 1·3 | 0·6 | most preferred |
| *Cenchrus setigerus* | 1·3 | 0·6 | most preferred |

*arenarius, Heliotropium marifolium, Cenchrus biflorus, Tragus racemosus, Aristida adscensionis* and *Corchorus* sp. In this community *Cenchrus ciliaris* in spite of having a low (1·8 per cent) occurrence in nature constituted 18·6 per cent of the food species, while *Digitaria adscendens*, which had the maximum occurrence of 17·3 per cent in nature, constituted 21·3 per cent of the rodent menu (Table 2), showing that the former species is more preferred. On the other hand, the occurrence of *Tribulus terrestris* was 12·0 per cent in nature and it constituted only 2·6 per cent of gerbil food. *Brachiaria ramosa* and *Perotis hordeiformis* having higher frequency were rated as less preferred and not preferred, although their occurrence percentages were 9·5 and 10·7 respectively. Some of the species having higher frequency of occurrence in the community were not eaten. 89·0 per cent of the gerbil food in this community comprised of grasses.

(c) *Cyperus arenarius—Digitaria adscendens—Pulicaria wightiana—Justicia vahlii* community.

The plant community occurred on an inter-dune sandy plain. The first two species in this community had 100 per cent frequency in the transects, and the latter two had 83·3 per cent frequency. *Eragrostis cilianensis* and *Tragus biflorus* had a frequency of 66·6 per cent. In this community *Cenchrus ciliaris* formed 25·5 per cent and *Eragrostis cilianensis* 8·5 per cent of the gerbil food in spite of being only 4 and 0·5 per cent respectively in nature (Table 3), indicating that they are most preferred by the desert gerbils. *Cyperus arenarius* and *Digitaria adscen-*

TABLE 3

PER CENT OCCURRENCE OF UNCONSUMED PLANT SPECIES NEAR GERBIL BURROW OPENINGS AND IN NATURE, AND THEIR PALATABILITY CLASSES IN THE PLANT COMMUNITY(C)

| Plant species | Per cent occurrence | | Palatability classes |
|---|---|---|---|
| | Unconsumed plant species near burrow openings | in nature | |
| *Cenchrus ciliaris* | 25·5 | 4·0 | most preferred |
| *Cyperus arenarius* | 17·0 | 24·5 | less preferred |
| *Digitaria adscendens* | 8·5 | 14·0 | less preferred |
| *Aristida adcensionis* | 8·5 | 2·0 | most preferred |
| *Eragrostis cilianensis* | 8·5 | 0·5 | most preferred |
| *Cynodon dactylon* | 6·3 | 2·0 | most preferred |
| *Polycarpaea corymbosa* | 6·3 | 1·5 | most preferred |
| *Eragrostis ciliaris* | 4·2 | 4·5 | less preferred |
| *Tragus biflorus* | 4·2 | 4·5 | less preferred |
| *Eleusine compressa* | 4·2 | 0·5 | most preferred |
| *Trichodesma indica* | 2·1 | 2·5 | less preferred |

*dens* have a higher occurrence (24·5 and 14·0 per cent respectively) in nature as compared to that in the gerbil food (17·0 and 8·5 per cent respectively) and both the species are rated as 'less preferred'. *Pulicaria wightiana* and *Justicia vahlii*, though predominantly occurring in nature, did not at all occur as gerbil food. In this community, grasses formed 73·1 per cent of the gerbil food.

(d) *Pulicaria wightiana—Justicia vahlii—Polycarpaea corymbosa—Sporobolus helvolus* community.

This community was situated on the flat top of a sand dune. All the four species forming the community had 100 per cent frequency in the transects. *Aristida adscensionis* and *Convolvulus microphyllus* had 75 per cent frequency. All the dominant species of the community were absent from the gerbil food except a low (4·5 per cent) occurrence of *Sporobolus helvolus* as against 17·5 per cent (Table 4) incidence in nature which shows that the species was not preferred by gerbils. *Cenchrus ciliaris*, the occurrence of which is maximum in the gerbil food, was absent in this community and the desert gerbil showed lesser selectivity

TABLE 4

PER CENT OCCURRENCE OF UNCONSUMED PLANT SPECIES NEAR THE BURROW OPENINGS AND IN NATURE, AND THEIR PALATABILITY CLASSES IN THE PLANT COMMUNITY(d)

| Plant species | Per cent occurrence | | Palatability classes |
|---|---|---|---|
| | Unconsumed plant species near burrow openings | in nature | |
| *Brachiaria ramosa* | 22·7 | 4·0 | most preferred |
| *Perotis hordeiformis* | 13·5 | 4·0 | most preferred |
| *Cenchrus biflorus* | 9·0 | 4·0 | most preferred |
| *Aristida adscensionis* | 9·0 | 3·2 | most preferred |
| *Convolvulus microphyllus* | 9·0 | 2·4 | most preferred |
| *Sporobolus helvolus* | 4·5 | 17·6 | not preferred |
| *Fimbristylus barbata* | 4·5 | 3·2 | preferred |
| *Digitaria adscendens* | 4·5 | 0·8 | most preferred |
| *Boerhavia diffusa* | 4·5 | 0·8 | most preferred |
| *Glinus hirta* | 4·5 | 0·8 | most preferred |
| *Tragus biflorus* | 4·5 | 0·8 | most preferred |

in preferring various food species when compared to other communities in which it was present. *Perotis hordeiformis*, rated not preferred in community (b) was rated as most preferred. Moreover, all the species except *Sporobolus helvolus* and *Fimbristylis barbata* were rated as most preferred. It appears, therefore, that in the presence of the choicest species, the rodents do not show selectivity in choosing their food. In this community 89·0 per cent food comprised of various species of grasses.

## II. Palatability Index of various plant species

Table 5 shows that out of the seven species which occurred as food item in more than two communities, the first six belong to family Poaceae which indicates that the Indian Desert Gerbil, *Meriones hurrianae*

TABLE 5

PALATABILITY INDEX OF UNCONSUMED PLANT SPECIES OCCURRING IN MORE THAN TWO COMMUNITIES, AS RATED BY DESERT GERBILS

| Plant species | Family | No. of communities in which occurred | Palatability Index |
|---|---|---|---|
| *Cenchrus ciliaris* | Poaceae | 3 | 4·0 |
| *Aristida adscensionis* | Poaceae | 4 | 3·7 |
| *Eragrostis ciliaris* | Poaceae | 4 | 3·0 |
| *Digitaria adscendens* | Poaceae | 4 | 2·7 |
| *Brachiaria ramosa* | Poaceae | 3 | 2·6 |
| *Tragus biflorus* | Poaceae | 3 | 2·6 |
| *Cyperus arenarius* | Cyperaceae | 3 | 2·3 |

mainly feeds on grasses. *Cyperus arenarius* (Cyperaceae) was the only non-grass species to occur in this hierarchy of preference but it is rated lowest as compared to other six grasses. All these grasses are palatable to livestock.

## III. Field observations on Desert Gerbil food

Observations with binoculars revealed that the gerbils fed mostly on shoots, leaves and inflorescence of plants. In an earlier study (Prakash 1962) on the examination of stomach contents it was found that during monsoon season the occurrence of these plant parts increased whereas in other seasons, seeds formed their main food. The following plant species were observed being consumed by the gerbil.

Family POACEAE

1. *Cenchrus ciliaris*
2. *Cenchrus setigerus*
3. *Cenchrus biflorus*
4. *Aristida adscensionis*
5. *Digitaria adscendens*
6. *Eleusine compressa*
7. *Cynodon dactylon*
8. *Eragrostis ciliaris*
9. *Eragrostis cilianensis*

10. *Dactyloctenium aegyptium*
11. *Brachiaria ramosa*
12. *Perotis hordeiformis*
13. *Tragus biflorus*

Family CARYOPHYLLACEAE

14. *Polycarpaea corymbosa*

Family CYPERACEAE

15. *Cyperus arenarius*

Family ZYGOPHYLLACEAE

16. *Tribulus terrestris*

Family MOLLUGINACEAE

17. *Glinus hirta*

Family CUCURBITACEAE

18. *Cucumis callosus*
19. *Citrullus colocynthis*

Family NYCTAGINACEAE

20. *Boerhavia diffusa*

Family CONVOLVULACEAE

21. *Convolvulus microphyllus*

Out of 21 species eaten by the Desert Gerbil, 13 were grass species and most of the plants observed being fed on by the gerbil are those which were found unconsumed near gerbil burrow openings. Thus, besides consumption there is also perhaps a larger amount of destruction through the cut and unconsumed material.

## IV. Economic consideration

In the desert tract, where the study was conducted, the density of Desert Gerbil was estimated to be 477 per hectare. Considering that a gerbil consumes about 6 gm. feed per day (Prakash & Kumbkarni 1962), their annual requirement will be 1044 kg./hectare[1] ; assuming that their number will be maintained at this level all the year round.

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[1] The cost of this fodder will be about Rs. 225.68 per hectare at the rate of Rs. 20.00 per quintal.

The figures of the estimated forage production in this tract during 1963-64 and 1964-65 are summarised in Table 6 (Ahuja, Personal communication). Comparing the gerbil depredation and forage production figures, it will be observed that hardly any fodder will be left for

TABLE 6

FORAGE PRODUCTION (AIR DRIED) PER HECTARE AT MAULASAR

| Forage species | Forage production (air dried) per hectare, kg. | |
|---|---|---|
| | 1963-64 | 1964-65 |
| 1. Edible grasses ; High perennials (*Cenchrus* spp.) | 332 | 196 |
| Low perennials (*Eleusine compressa*, *Cynodon dactylon*, etc.) | 31 | 8 |
| *Cyperus* spp. | 25 | 8 |
| Annuals (*Aristida* spp., *Cenchrus biflorus*, *Digitaria adscendens*, *Tragus biflorus* etc.) | 822 | 307 |
| Total edible species | 1210 | 519 |
| 2. Non-edible species | 159 | 315 |
| Total forage production | 1369 | 834 |

livestock, particularly when the estimate of the gerbil consumption does not include the destruction they do merely by cutting the grasses to reach the inflorescence. The rodents also destroy the vegetation by damaging their roots by tunnelling and expose the loose soil excavated from these tunnels to wind, thus affecting grass growth. All these factors in their turn affect the establishment of good pastures for proper livestock industry which largely depends on these pastures. It is, therefore, essential that control operations are to be visualised while planning improvements to rangelands.

## ACKNOWLEDGEMENTS

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data on forage production ; and to Sarvashri Bajrang Lal Sain and Hari Prasad Sharma for assistance during the field work.

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# On a new species of sea anemone from Maharashtra, India

BY

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(*With four text-figures*)

*Anthopleura panikkarii* a new species of intertidal sea anemone from India is described. Detailed notes on ecology, external morphology and anatomy are given.

The paper describes a new intertidal sea anemone collected from Vengurla Port, Ratnagiri (Mirkarwadi) and Bandra Point, Bombay, along the coast of Maharashtra, India, during 1966-68. It was first identified as the Japanese species, *Anthopleura midori* (Uchida 1958), which has been reported from Bombay by Parulekar (1968). However, observations on a large number of living specimens showed it to be an undescribed species. The new species is named after Dr. N. K. Panikkar, in recognition of his valuable contributions to actinian research in India.

## **Anthopleura panikkarii** sp.nov.

(Text-figures 1-4)

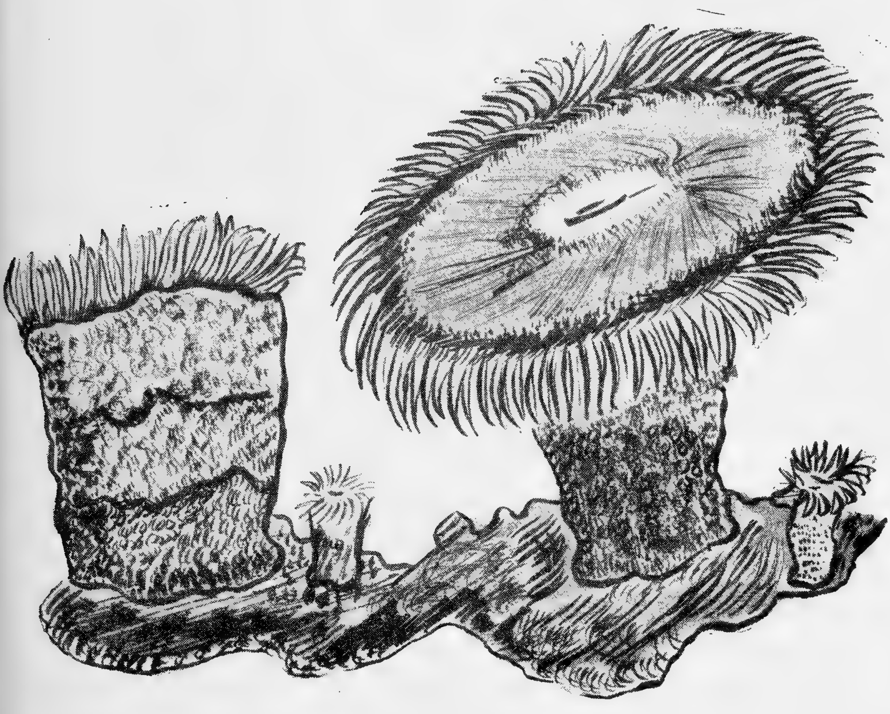
*Material :* Holotype (Reg. No. P 1858/1) in the collections of the Zoological Survey of India, Calcutta, collected at Vengurla Port (15° 51′N., 73° 37′E.), Maharashtra, India in April 1967. Paratypes : Five specimens collected from Vengurla Port, Ratnagiri ; Bandra Point, Bombay (Maharashtra) and Kalangut (Goa). These will also be deposited in the collections of the Zoological Survey of India, Calcutta.

*Diagnosis :* Actiniidae with well-developed basal disc, column with adhesive verrucae arranged in more or less distinct longitudinal rows, especially, in its upper part. Marginal spherules (acrorhagi) present. Sphincter weak or strong, restricted to circumscript. Tentacles simple, hexamerously or irregularly arranged, their longitudinal muscles ecto-dermal or meso-ectodermal. Numerous perfect mesenteries, all the stronger ones, fertile. Retractors of the strong mesenteries diffuse,

sometimes restricted. Younger mesenteries growing from the basal disc upwards. Cnidom : Spirocysts, basitrichs, holotrichs, microbasic p-mastigophores.

## Description

*General features :* A medium-sized anemone found firmly attached to sheltered side of rocks, in the upper marginal zone. Some specimens inhabit crevices of rocks. The characteristic feature of this actinian is the presence of green verruciform suckers on its column. In its habitat, the anemone frequently bears gravel and shell-fragments on its body. When contracted, it is cone-shaped, with an irregularly spreading base.



Text-fig. 1 : *Anthopleura panikkarii* sp. nov. : Showing the habitat.

*Size :* Shape and dimensions variable, depending on the state of expansion. A well-expanded specimen, is about 40 mm. in height and 27 mm. in width. The size-range for the species, based on measurements of 30 specimens, is as follows : length of column 10-40 mm. ; diameter of column 9-28 mm. ; diameter of oral disc 7-32 mm. ; diameter of basal disc 5-30 mm.

*Colour :* Column brick-red with dirty-green verruciform suckers,

Marginal spherules pinkish or flesh-coloured. Tentacles uniformly blood-red. Oral disc red with greenish tinge. Basal disc flesh-coloured.

*Basal or pedal disc :* In live specimens, firm, well-developed and more or less irregular in outline when contracted, and rounded, when expanded. Rounded or oval in a well-preserved specimen. It is only in a contracted living specimen that its diameter is greater than that of the column or oral disc.

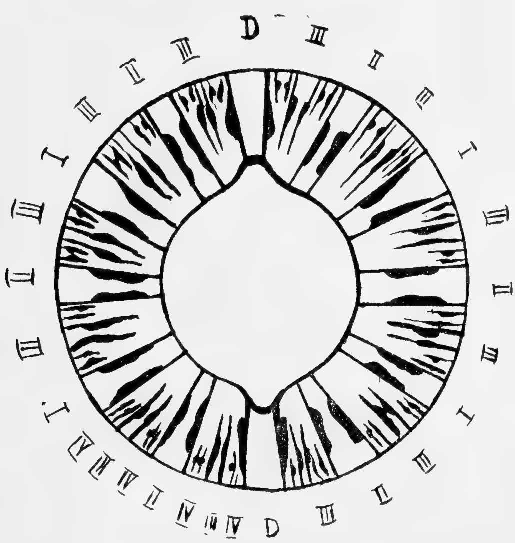
*Column :* It assumes different shapes, depending on the state of contraction or expansion. When contracted, it becomes cone-shaped or dome-like with upper part thickly covered by verruciform suckers. In a fully-extended condition, the anemone is pillar-like with narrow basal part and broad distal part. When elongated, the column is long and cylindrical, its height being more than twice the diameter. The gravel and shell-fragments are borne only on the upper part. Ectoderm cells are cylindrical and vesiculated. Endoderm cells rather low, cylindrical and filled with black granules. *Verrucae* : The column is studded with papillated verruciform suckers, arranged in 96 longitudinal rows swollen and cone-shaped in a fully expanded live specimen but long and papillose in preserved ones. They are densely set in the upper part, but are sparse near the base. The uppermost suckers, are the largest, possessing a pit in the centre. In a contracted specimen, the suckers near the oral disc form a dense ' Papillose collar ', thus completely concealing the acrorhagi. In young anemones, the verruciform suckers are seen only in the upper part of the column. *Acrorhagi* or *Marginal spherules* : The upper limit of the column is marked by the presence of acrorhagi or marginal spherules, which are pinkish or flesh-coloured in the living anemone. In a well-grown anemone, they are lobed in appearance. The number varies from individual to individual but in a well-grown specimen, there are 48 of them. The basal part of the acrorhagi is vacuolated and slightly glandular, but the distal part is closely set with long spirocysts.

*Oral disc and Tentacles :* Rounded to oval in shape, with diameter more or less equal to that of the column but always more than that of the basal disc. An elliptical mouth, with two siphonoglyphs, marks the centre of the oral disc. Tentacles arranged in 5 cycles in a hexamerous plan of 6+6+12+24+48=96. Broad at the base and gradually taper towards the tip. Nearly equal in length except for the outermost cycle, which are slightly shorter. Tentacles of the two inner cycles are, during expansion, held in an upright position while the others, especially, those of the outermost cycle (Vth) are either curved, outwards or downwards. Muscles of the tentacle are ectodermal and sparsely branched. Endodermal muscles with numerous foldings, occur in the oral disc. Marginal

sphincter (Text-fig. 2) well-developed, almost oval in shape asymmetrically circumscribed, pedunculate pinnate, with numerous foldings.

Text-fig. 2: *Anthopleura panikkarii* sp. nov.: Marginal sphincter in radial section.

*Mesenteries:* Hexamerously arranged in four cycles of 6+6+12+24=48 pairs, of which two are directives (Text-fig. 3). The first two cycles are perfect. All mesenteries, except directives are provided with



Text-fig. 3: *Anthopleura panikkarii* sp. nov.: Mesenterical arrangements (diagrammatic).

filaments, and are fertile. They have well-developed longitudinal muscles, which are diffuse, circumscribed. The muscle pennons of the directives

give rise to a number of foldings (Text-fig. 4). The muscle foldings of the first and the second cycle of mesenteries are narrow with a long extension possessing shallow foldings. Those of the third cycle are rather


Text-fig. 4 : *Anthopleura panikkarii* sp. nov. : Sections of mesenteries.

circumscribed, and of the fourth often crescentic. In the lower part, the parietobasilar and the basilar muscles are well-developed.

*Cnidom :* The distribution and size (in microns) of nematocysts, are as follows :—

| | | | | |
|---|---|---|---|---|
| *Tentacles :—* | | | | |
| Spirocysts | .. | .. | .. | 9·8-25·2 × 2·1-3·5 |
| Basitrichs | .. | .. | .. | 18·2-19·6 × 2·1 |
| *Body-wall* | | | | |
| Basitrichs | .. | .. | .. | 7·9-15·5 × 1·4-2·2 |
| Holotrichs | .. | .. | .. | 12·6-16 × 1·4 |
| Microbasic- p-mastigophores | | .. | .. | 15·4-19·6 × 2·8-3·5 |
| *Acrorhagi* | | | | |
| Basitrichs | .. | .. | .. | 9·8-16·8 × 1·4-2·1 |
| Spirocysts | .. | .. | .. | 14·0-23·8 × 2·1-2·8 |
| Holotrichs | | .. | .. | 36·4-53·2 × 2·4-5·6 |

*Septal filaments*

| | |
|---|---|
| Basitrichs .. .. .. | 15·4-19·6×2·8-3·5 |
| Microbasic p-mastigophores .. .. | 17·5-19·6×3·5-4·2 |
| Microbasic p-mastigophores .. .. | 26·6-29·4×2·8-4·2 |

*Remarks:* This actinian closely resembles, *Anthopleura midori*, the 'Green Sea Anemone' of Japan, described by Uchida (1958). They resemble in habitat, presence of green verruciform suckers, similar type of mesenterial arrangement etc., but differ in coloration, structure of marginal sphincter in section, presence of acrorhagi in all stages of growth and the distribution and size of nematocysts.

## Acknowledgements

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# Observations on the Breeding Biology of Finn's Baya (*Ploceus megarhynchus* Hume) in the Kumaon Terai

BY

V. C. Ambedkar

(*With a plate*)

The observations presented here were made during three field trips to Rudrapur, Kumaon terai, Dist. Nainital, in 1961, 1962 and 1963. It was ascertained that Finn's Baya has two distinct breeding periods, the first, May to middle of July, the second in August-September. The observations show that in the first period the birds build their nests on tree-tops, and in the second low down among *Typha* reed-beds standing in water. Clutch-size, incubation and nestling periods, and nesting success were studied for the first time. Finn's Baya is a polygamous species practising successive polygamy. The male alone builds the nests while the female is almost wholly responsible for the domestic duties. Mud-blobs were observed in the nests as in those of other Indian weavers; their significance remains obscure.

## Introduction

In recent years, particularly after the re-discovery of the Finn's Baya (*Ploceus megarhynchus*) in Kumaon terai (Ali & Crook 1959), there has been considerable interest on two aspects of the biology of this endemic Indian weaver bird, namely the taxonomy of the species (Abdulali 1952, 1954, 1960), and the unusual breeding habits. This paper is a report chiefly on some quantitative aspects of the breeding biology of the bird. The field work was carried out during the breeding seasons of 1961, 1962 and 1963 in Kumaon terai, District Nainital, Uttar Pradesh, under the direction and active participation of Dr. Sálim Ali.

Three other weavers namely the Common Baya (*Ploceus philippinus*), the Blackthroated Baya (*P. benghalensis*) and the Striated Baya (*P. manyar*) also breed in the same area. The selected study area had all the four species breeding so that it might be possible to assess the ecological niche of each species.

## Study area

Rudrapur was selected as the base for the study as the town stands in the midst of the terai, and is well connected by roads with Moradabad,

Rampur and Bareilly. The following villages were visited during field trips : Haldwani, Fatehpur (Bhabar area), Lalkua, Bilaspur, Ghadarpur, Sitarganj, Sultanpur (Terai area) all situated within a radius of fifteen miles of Rudrapur.

## Materials and Methods

The field work mainly consisted of direct observations of nests and birds, using 6×30 prismatic binoculars. Birds, both adult and nestling, were marked with aluminium rings of the Bombay Natural History Society, and coloured celluloid rings for individual identification. Adults were caught with nylon mist nets. Weights of the young and eggs were taken by a spring balance. The colonies were visited early in the morning and observations were continued till late in the evening but for a short break at mid-day.

## Field Characters

Finn's Baya differs from other weaver birds by its larger size and bill although in non-breeding plumage differentiation from the Common Baya in the field is not always certain. In breeding plumage the male is brilliant golden yellow with black wings. The black beak is decidedly larger than that of other weaver birds. In some males the vent area is white and can be clearly seen from a distance, one of the characters on which the eastern race is separated from the western race by Abdulali (1960). The female is in general coloration pale yellow with dark-brown wings. The males utter a harsh *twit twit* during flight from one place to another. Very often they descend on cart-tracks, and even on asphalted roads to pick up grains, spilt during transport. The birds appeared to be very fond of hemp seeds. The females, just prior to the breeding season, usually move in separate flocks of their own sex.

Table 1

| | 3 ♂♂ | 7 ♀♀ |
|---|---|---|
| Wing | 69 - 79 mm. | 66 - 73 mm. |
| Weight | 34 - 40 gm. | 30 - 34 gm. |

Juvenile males are very similar to the females but can be identified in the field by the call note which is similar to that of adult males. The juvenile males move in flocks of their own, which do not intermix with the breeding population as observed also in the Common Baya (Ali 1931, Ambedkar 1964).

Amongst the breeding males, at least one or two males have a complete black breast-band (BNHS Ring No. AB 1808), which is quite unusual.

## Ecology

### Habitat

The breeding birds frequent the swampy area of the terai, a belt 10-12 miles in width with extensive luxuriant growth of elephant grass (*Imperata*), and other grasses, dotted with *Salmalia malabarica* and *Sheesham* (*Dalbergia sisoo*) trees. Patches of bulrushes (*Typha*) occur along ditches, ponds and swamps. Insects are abundant and various species of insect-eating birds are characteristic of the area. Warblers of the genera *Cisticola*, *Prinia*, *Acrocephalus* are extremely common, and their call notes very frequently heard.

In 1961, between 1 July and 20 August, I found twenty-one breeding colonies of Finn's Baya on trees, and the total number of nests counted was about eight hundred. The trees being isolated or well spaced-out in the grassland, I feel that I counted all the colonies within a radius of fifteen miles. The trees selected for nesting were : *Salmalia malabarica*, *Sheesham* (*Dalbergia sisoo*), Mango (*Mangifera indica*), and Flame of the Forest (*Butea monosperma*). A colony on a dead *Salmalia* near the fish culture pond at Rudrapur was observed in 1961 and again in 1962 and suggests that Finn's Baya uses traditional nesting sites as observed in the Baya (Ali 1931, Ali & Ambedkar 1956, 1957, and Crook 1960).

Although almost all the colonies were located away from human habitations, yet there was one extraordinary nesting colony observed right in the centre of Sultanpur village, about six miles from Rudrapur on the Rudrapur-Ghadarpur road on 14 July, 1961. A leafy banyan tree, (*Ficus bengalensis*), about fifty feet high was selected, not only by Finn's Bayas but also by the Common Baya, the Pied Myna (*Sturnus contra*) and the Drongo (*Dicrurus adsimilis*), for nesting. The uppermost stratum of the tree was occupied by Finn's Baya with fifty completed nests. The nesting was nearly completed by mid-July since many nests looked deserted and were being constantly visited and inspected by a flock of the White-throated Munia (*Lonchura malabarica*). Female Finn's Bayas, still feeding young, collected insects from elephant grass about a hundred yards from the tree. The second stratum was selected for nesting by the Common Baya which had nearly seventy completed nests. Breeding was in full swing and there was constant traffic of birds bringing food for the growing young and nesting materials for construction of new nests. All these were collected from the different patches of grassland in the neighbourhood. Apparently Finn's Baya and the Common Baya do not compete for food and nesting materials. The third stratum was selected for nesting by a pair of Drongos (*Dicrurus adsimilis*) which had three young in the nest. And the last and lowest portion of the foliage canopy,

about ten feet above the ground, held a nest of the Pied Myna (*Sturnus contra*), apparently incubating. The entire colony was benefited by the alertness and fearlessness of the drongos, who constantly drove off crows (*Corvus splendens*) and pariah kites (*Milvus migrans*) approaching the tree.[1]

Detailed observations on the nest construction and breeding behaviour of Finn's Bayas breeding on tree-tops were provided by Sálim Ali & Crook in 1959 who stated that ' but for the builders in attendance among the tree-top, one would have hardly thought of looking for a nest colony in such a situation, or recognised such completely unorthodox structures as nests of an Indian weaver bird '. The nests were described as ' unlike those of any other Indian weaver. They are large globular structures, untidily but firmly woven with long strips of coarse grass, and the entrance is at one side near the top. Often a porch-like projection surrounds the entrance forming a small papilla as often seen in munia's nests. The structures are usually firmly knotted to upright twigs which are often worked into the fabric and also support the body of the nests from below. Occasionally the nests are slung sideways on to a twig or two so that the nest chamber hangs free below it. In no case, however, are the nests truly suspended from fine single twigs as is normally the case with the Common Baya (*Ploceus philippinus*) (Ali 1931) '.

During field trips to the Kumaon terai I observed nesting colonies mainly on tree-tops in July (1961), prior to the monsoon, and in reed beds after the rains had properly set in (1962, 1963). The nesting colonies observed in reed beds were recorded for the first time in the Kumaon terai as described here.

C. V. O'Donel (Baker 1926, 1934) observed the breeding of Finn's Baya [since described as a new subspecies, *Ploceus megarhynchus salimalii* Abdulali (1960)] in Bhutan Duars in the year 1912 and described its nesting habitat as ' a vast area of grass more or less intermixed with scrub '. Sálim Ali & Crook (1959) also observed some half-completed nests and structures in reeds standing in water in Kumaon terai but they considered these as the work of first year juveniles merely ' doodling ' with nesting materials. Further they remarked that they did not see any females visiting these nests.

[1] I visited the same tree on 3 September, 1968, and except for Finn's Baya, all the other ' tenants ' were in occupation. Perhaps the absence of Finn's Baya is due to the absence of elephant grass from the surrounding area which is now under cultivation.

## Breeding Behaviour

In 1962 an active reed bed colony was located near Rudrapur at the end of July. The dates of the various stages of this colony (Fish Culture Pond Colony) were as follows :

Table 2

| | |
|---|---|
| Establishment of the Colony | 26 - 30 July |
| Nest construction | 1 - 6 August |
| Egg-laying | 5 - 12 August |
| Hatching | 18 - 24 August |
| Feeding the young | 18 August - 3 September |
| Young leaving the nests | 29 August |
| End of nesting activities | 4 - 8 September |

### Colony site

The colony was located in a reed bed adjacent to the Fish Culture Pond on the Rudrapur-Phoolbagh road about one mile from Rudrapur. The reed bed of *Typha* reeds was roughly half an acre in area. Some of the *Sheesham* trees along the adjacent main road were occupied by the birds in May and June, but none were active in August after the rainy season had properly set in. In the centre of the reed bed, dead and dry, upright, bulrush (*Typha*) stems were available for nesting; for the inspection of the nests one had to wade through knee-deep water. Although fresh leaves and stems were readily available yet the birds selected dry, stiff, upright stems for the construction of their nests.

Other similar colonies were observed in the vicinity of Rudrapur in 1962 and 1963 which suggests that the breeding of Finn's Baya in reed beds once the rains have set in, is a regular feature.

### Nest Construction

The male Finn's Bayas, who were the first to arrive on the nesting site, started to construct nests after plucking off the green flexible leaves, leaving behind stiff, bare stems of the *Typha*. The females did not help the males at this stage, but their hidden presence nearby could be detected by the display of the males.

The nest was rather loosely constructed of coarse long, green and flexible strips of elephant grass. Unlike the Bayas' nest, the nests were not pendant but attached firmly to the upright stalks of *Typha*. The general structure and stages in nest construction are remarkably similar to that of the *Quelea* nests of Africa (Morel, Morel & Bourliere 1957, Collias & Collias 1964).

Following are the stages of nest construction :

(1) *Crescent shape*

The male Finn's Baya, after the selection of *Typha* stems tied two or three dry upright stems with a few strands of coarse grass, like a waist

Ambedkar : Finn's Baya

*Above :* A reed bed nest colony; *Below :* Close-up of reed bed nests.
(*Photos : Sálim Ali*)

belt, just a few inches above water level, in such a way that the upper free ends came closer together. Then he started the construction of the nest at about 8-14 inches above the belt. By knotting one or two stems and picking the loose end with his beak from the third stem he constructed a bridge-like structure. After adding more material to this structure it became a firm bed of grass on which he could stand to construct the main body of the nest.

(2) *Initial Ring with Pouch*

This is the most important stage in the nest construction. It forms the base of the nest, and it is at this stage that the prospecting females visit the colony and the nests for inspection (Ali 1931) and, if approved, appropriate them for laying the eggs. After the first stage of nest construction the male immediately started on the next stage—the ' Ring with Pouch '. By adding more strands the male made a ring-like structure, and with shaping movements he prepared a ball-like pouch which hung down in the opposite direction to the entrance. By repeatedly adding more material he made a nest with a wide entrance. At this stage also as in other Indian weavers, he added the mud-blobs, within the nest, whose function still remains unknown. As soon as the female arrived he acknowledged her presence with a joyous *twit-twit-twit,* and often jumped in the air to greet her and then both came back to the nest, the male landing on the outer wall of the nest, the female within the ring. Copulation often occurred at this stage, if the female permitted.

(3) *Complete nest with wide entrance*

This is the stage when more vigorous activity to complete the nest took place. Pilfering of materials from other nests was a common sight in the colony. More strands were added to thicken the outer wall of the nest. The male brought lining material particularly *Typha* floss which was readily available in the colony. Unlike other weavers this lining was plastered all along the entire inner wall of the nest but more profusely at the bottom of the egg chamber. The floss lining along the entire inner wall probably serves as insulation and for keeping out the rain. After weaving and interlacing more nesting materials, the outer structure presented a coarse crisscross appearance, the entrance of the nest was narrowed down to permit entry of a single bird only. This was the final stage in the nest construction which took roughly between three and five days to complete. The shape of the completed nest was oval with a high lateral entrance. In some cases two entrances were seen. The female spent much time now in the nest and started laying. The male went on to construct a second nest often attached to the first one, in effect converting it into a composite double or multi-chambered structure. These functional composite nests, commonly to be seen in

Finn's Baya colonies, are unique among the Indian weaver birds. In the above colony I observed a compound nest which consisted of seven nests belonging to two males. The entire structure was built on ten dry *Typha* stems. The nests were not inter-connected, each unit being quite independent, with separate entrances. Other instances of this kind in ploceidae are known in the case of the Black Buffalo Weaver of Africa (Chapin 1954, Crook 1964, Collias & Collias 1964) and the giant and spectacular compound nests of the Sociable Weaver (*Philetairus socius*) of South Africa (Friedmann 1950).

In this reed bed it was noted that the nests, which were at the centre of the colony, were very active attracting other birds to build nests around the centre and particularly near the compound nests. The compound nests probably acted as the centre of social stimuli and no doubt served to orientate prospecting females. The peripheral nests always remained undeveloped.

The average weight of the dry nests was found to be 66·8 gm.

One of the basic differences in the breeding biology of Finn's Baya from that of the other Indian weaver birds seems to be that if the nests of Finn's Baya are removed then they abandon the colony site and move elsewhere, whereas other weavers even after repeated destruction of the nests, build again and again at the same site.

### Clutch-size

Table 3 shows the average clutch-sizes of Finn's Baya for the years 1959, 61, 62 and 63. To understand the frequency of the clutch-sizes, data from Ali & Crook (1959) are also incorporated here for comparison. The average clutch-size in the tree-top nests was 2·3 in 1959 and 2·5 in 1961 ; in the reed bed nests it was 2·6 in 1962 and 2·3 in 1963.

TABLE 3

CLUTCH-SIZE

| *Year* | *Number of eggs in clutch* | | | | | | *Total* |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| 1959* | .. | 4 | 2 | .. | .. | .. | 6 |
| 1961 | 1 | 4 | 3 | .. | 1 | .. | 9 |
| 1962 | 3 | 8 | 23 | 10 | 5 | .. | 49 |
| 1963 | 2 | 3 | 5 | .. | .. | .. | 10 |
| | 6 | 19 | 33 | 10 | 6 | .. | 74 |

* Data collected by Sálim Ali & Crook.

Out of 74 clutches observed, 33 clutches or 44·6% had 3, while 19 clutches or 25·6% had 2 eggs each. The average clutch-size in the four years was 2·4 which is decidedly lower than that of the Common Baya recorded as 3·2 in the Poona area (Ambedkar 1964). Moreau (1944) has observed that in various other bird families e.g. Podicipidae, Falconidae, Sylviidae and also Ploceidae there is a tendency for the larger members of the same family to lay smaller clutches.

Due to the short periods of my stay at Rudrapur in all three years it was not possible to collect data on the clutch-sizes and to study various other aspects of the tree-top nests *versus* reed bed nests in any one year to determine if there was a difference in clutch-sizes laid in two entirely different periods of the same year and in the different situations. It is possible that in the terai the available food in different months of the year, and the different nesting sites, have some bearing on the clutch-sizes. Repeat clutches have not been recorded during the investigation.

## Egg weight

The eggs were laid daily, mostly in the morning. The first egg was laid in the Colony on 5th August 1962 before 7.30 a.m. This egg was observed in a nest where the males were building their nests in close contact which formed the compound nests. Probably the females were attracted first to these compound nests due to two possible factors (1) social stimuli received through the courtship activities of the males (2) safety from predators.

The weights of the fresh eggs were determined for the first time in 1962. The heaviest egg was 3·1 gm. and the lightest weighed 2·1 gm. The average weight was 2·7 gm. It is a common tendency in Finn's Baya for the second egg to be heavier than the first as shown in Table 4.

TABLE 4

WEIGHT IN GMS. OF 1ST AND 2ND EGGS OF A CLUTCH

| *No.* | *1st egg* | *2nd egg* |
|---|---|---|
| 1 | 2·8 | 2·9 |
| 2 | 2·1 | 2·2 |
| 3 | 2·6 | 2·8 |
| 4 | 2·6 | 3·0 |
| 5 | 2·6 | 2·8 |
| Mean | 2·54 | 2·74 |

It is, at the present state of knowledge, not possible to explain the significance of this consistent difference in weights.

### Incubation

Incubation is performed by the female alone, as in other Indian weaver birds. The nests were well insulated due to interior lining of the entire inner wall of the nests. In view of this insulation of the nests and high atmospheric temperature, it was not surprising to see the extreme irregular movements of the females which sat on the eggs for a few minutes ranging from ten seconds to eight minutes. There was constant inward and outward traffic of the females in the Colony and the Colony appeared to be most lively and active at this stage and the next stage of the breeding cycle. Incubation usually started from the first egg, and here the period was reckoned from laying of the first egg to its hatching.

Night brooding was carried out only by the females entering the nests before sunset. The eggs were inspected each morning for hatching. The data in Table 5 show that the most frequent incubation period was 14 and 15 days.

TABLE 5

INCUBATION PERIOD

| *Incubation period (days)* | *No. of clutches* |
|---|---|
| 13 | 7 |
| 14 | 10 |
| 15 | 10 |
| 16 | 8 |

Average for 35 clutches—14·5

It is interesting to note that Finn's Baya has a shorter incubation period, 14·5 days than that of the Common Baya 16·5 days (Ambedkar 1964).

### Nestling period

The female Finn's Baya broods the young during night in the same way as she incubates the eggs. She rarely stays in the nest after the 3rd or 4th day of hatching. The young are mostly fed on insects collected only by the female from the neighbouring area. The male usually does not collect food but guards his nests alertly from enemies, particularly crows. Throughout the day he perches on the nests singing and chirruping. Feeding by regurgitation is common for the first two or three days and thereafter the female brings morsels large enough for the young to swallow. In some cases the feeding instinct was observed to be present also in the males. On 3rd September, 1962, the male who was guarding the nest, fed the young with insects brought by the female,

The female passed on the food to the male to deliver it to the young. She was making continuous foraging trips.

The first young hatched in the colony was on 18th August afternoon. Almost all the eggs hatched between 18th August and 24th August, in a week's time. This was the most active part of the breeding cycle and the birds were constantly going out of the Colony in flocks for collecting food and bringing new materials for adding to the nests. The nestling period of Finn's Baya is between 12 and 17 days as shown in Table 6.

TABLE 6

| *Days after hatching* | *No. of young flew off* |
|---|---|
| 12 | 7 |
| 13 | 11 |
| 14 | 13 |
| 15 | 9 |
| 16 | 1 |
| 17 | 1 |
| | 42 Total |

Based on forty-two observations, the mean, maximum and minimum nestling period was recorded. Twenty-four young flew off successfully when they were 13 and 14 days old. The mean period was 14·5 days. From available data it is considered as the shortest nestling period among the Indian weaver birds.

### Nesting success

Nesting success may be defined as the ratio of young that flew from the nests to the number of eggs laid. In the Fish Culture Pond Colony, out of 79 eggs laid, 55 eggs hatched (69·6%) and 42 young flew off successfully (53·1%). This high nesting success can be attributed to the following three factors (1) safe nesting site (2) very short breeding cycle (3) abundant food supply.

The breeding activities at this colony ended on 4th Sept., i.e., 39 days after commencement.

## PREDATORS

No predators were observed in the Colony (Dr. Sálim Ali's obs.) except parties of House Crows and Jungle Crows, whose efforts towards predation were unsuccessful. The crows were driven off by the male Finn's Baya as they attempted to enter the colony. They found it difficult

to stand on *Typha* stems these being too thin to grasp. Thus it appears that such sites are more protective than the tree-top sites, which are more vulnerable. In August 1963 a mixed party of House Crows and Jungle Crows raided a colony, which was situated on a *Sheesham* tree. They made repeated attempts to enter the colony, and finally one crow managed to pull out a nestling about eight days old through the entrance of a nest. After carrying it to the ground he plucked out the feathers with his powerful beak. Other crows joined the first one and there was a keen tussle to snatch the nestling.

No nest of the Tree-mouse (*Vandeleuria oleracea*) was observed within those of Finn's Baya's, though in the Kumaon terai, the mouse was noted in the nests of the Common Baya, Blackthroated Baya and Striated Baya.

At the roosting place, in a dense *Typha* reed patch, Finn's Bayas were often observed roosting around a Crow-pheasant (*Centropus sinensis*). As the crow-pheasant changed his roosting place, the entire flock of Finn's Baya followed and settled around him. Possibly the presence of the crow-pheasant gave the birds a sense of safety ?[1] Crook (1964) reported that the males attack or at least make feints at snakes and human beings.

## Acknowledgements

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[1] More likely collective precaution—Eds.

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# More additions to the crab fauna of Bombay State

BY

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(*With two plates*)

Taxonomic accounts of the Brachyuran fauna of the Bombay coast have been given in previous issues of this *Journal* (Chhapgar 1957, **54** : 399-439, 503-549 ; 1958, **55** : 582-585 ; 1961, **58** : 529-531). Collections of crabs made subsequent to these publications have revealed the occurrence of several new distributional records. A taxonomic description of eleven such forms is given below.

Tribe DROMIACEA

Subtribe DROMIIDEA

Family *DROMIIDAE*

Genus **Conchoecetes** Stimpson

**Conchoecetes artificiosus** (Fabricius)
(Plate I)

*Dromia artificiosa*, Fabricius, *Ent. Syst. Suppl.* : 360 (1798).

*Conchoecetes artificiosus*, Henderson, *Trans. Linn. Soc. London* (*Zool.*) (2)**5** : 407 (1893) ; Alcock, *Journ. As. Soc. Bengal* **65** : 151 (1896) ; Alcock, *Catal. Ind. Deca. Crust.* **1** : 41 (1901) ; Chopra, *Rec. Ind. Mus.* **35** : 28 (1933) ; Barnard, *Ann. S. Afr. Mus.* **38** : 308 (1950).

A female from Bombay represents the present collection.

| | |
|---|---|
| length of carapace .. .. .. | 15 mm. |
| breadth of carapace .. .. | 16 mm. |

The carapace is flat and pentagonal. The front is cut into three teeth, the middle being smaller and on a lower plane. There are two teeth on the lateral borders of the carapace—one immediately behind the cervical groove, the other behind the branchial groove.

The claws are massive, with two tubercles at the distal end of the outer surface of the wrist, and two on the palm near the fingers.

The third pair of legs are shorter than the first two pairs, but are as stout. They end in huge, talon-like dactyli. The last pair ends in tiny, claw-like dactyli. The sternal grooves of the female reach the level of the bases of the first pair of legs.

The crab protects itself by holding a valve of a bivalve mollusc over it.

Distribution: East coast of Africa to Japan and Australia.

## Tribe OXYSTOMATA

### Family *LEUCOSIIDAE*

### Subfamily LEUCOSIINAE

### Genus **Leucosia** Fabricius

#### **Leucosia pallida** Bell

*Leucosia pallida*, Bell, *Trans. Linn. Soc. London (Zool.)* **21** : 285 (1885) ; Alcock, *Journ. As. Soc. Bengal* **65** : 222 (1896) ; Sankarankutty, *J. Mar. biol. Assoc. India* **4**(1) : 154 (1962).

A female from Bombay represents the present collection.

The carapace is roundish. The true postero-lateral margins of the carapace are beaded up to the level of the second pair of walking legs. The posterior border is straight, and has toothed outer angles. The thoracic sinus is Y-shaped, there being six to seven granules in a row in the tail of the Y ; three to four of these granules are large and pearl-like. The front is tridentate and anteriorly distinctly concave in the midline.

The arms of the claws have 7 to 9 pearly tubercles arranged in two rows. The hand is more than $\frac{3}{4}$ as broad as long and has its outer border strongly keeled. The abdomen is four-segmented.

Colour greyish. There are two pairs of pale spots in the gastric region, and two brown spots in the posterior part of the carapace.

This species has been previously recorded from the Andaman Islands as well as the Persian Gulf.

#### **Leucosia vittata** Stimpson

*Leucosia vittata*, Stimpson, *Proc. Acad. Nat. Sci. Philad.* **159** (1858) ; Alcock, *Journ. As. Soc. Bengal* **65** : 232 (1896).

A female from Bombay is in the present collection.

The carapace is hexagonal, and is conspicuously longer than broad. The front ends in three horizontal prongs. The thoracic sinus has no

granules. Its outer branch encroaches into the antero-lateral borders of the carapace, causing a sharp emargination.

The body is blackish, with flame-coloured stripes.

It has been previously recorded from the Andaman Islands.

### **Leucosia longifrons** de Haan

(Plate I)

*Leucosia neocaledonica*, A. Milne-Edwards, *Nouv. Archiv. du Mus.* **10** : 40 (1874).
*Leucosia longifrons* var. *neocaledonica*, Alcock, *Journ. As. Soc. Bengal* **65** : 218 (1896).

A male from Bombay is in the present collection. It measures :—

| | | |
|---|---|---|
| length of carapace .. | .. | .. 23 mm. |
| breadth of carapace | .. | .. 20 mm. |

The true postero-lateral borders are beaded only as far as the level of the first pair of walking legs. The tail of the Y-shaped thoracic sinus bears a row of six to seven large pearly granules, in line with the milled epimeral edge of the carapace. The front is triangular.

Both the borders of the upper surface of the arm in the chelipeds bear a row of tubercles. Proximally there is also a patch of 6-8 coalescent granules, and five isolated ones. On the inner border of the wrist is a row of four granules. The inner edge of the hand bears several such rows.

The meropodites of the legs have three rows of granules. The propodites are keeled.

The anterior male abdominal appendages are bent at right angles at the tip to form a spirally twisted, spooned hook, bearing hairs. Just below the hook is a knob.

Colour greyish. On the gastric region are two large ocelli with small white centres and very broad red outer rings. Around the posterior half of the circumference of the carapace are six reddish spots. The legs are banded red. The fingers of the claw have their basal halves red, and the distal halves white.

Alcock records this species from the Persian Gulf, Karachi, and Palk Straits.

## Genus **Nursia** Leach

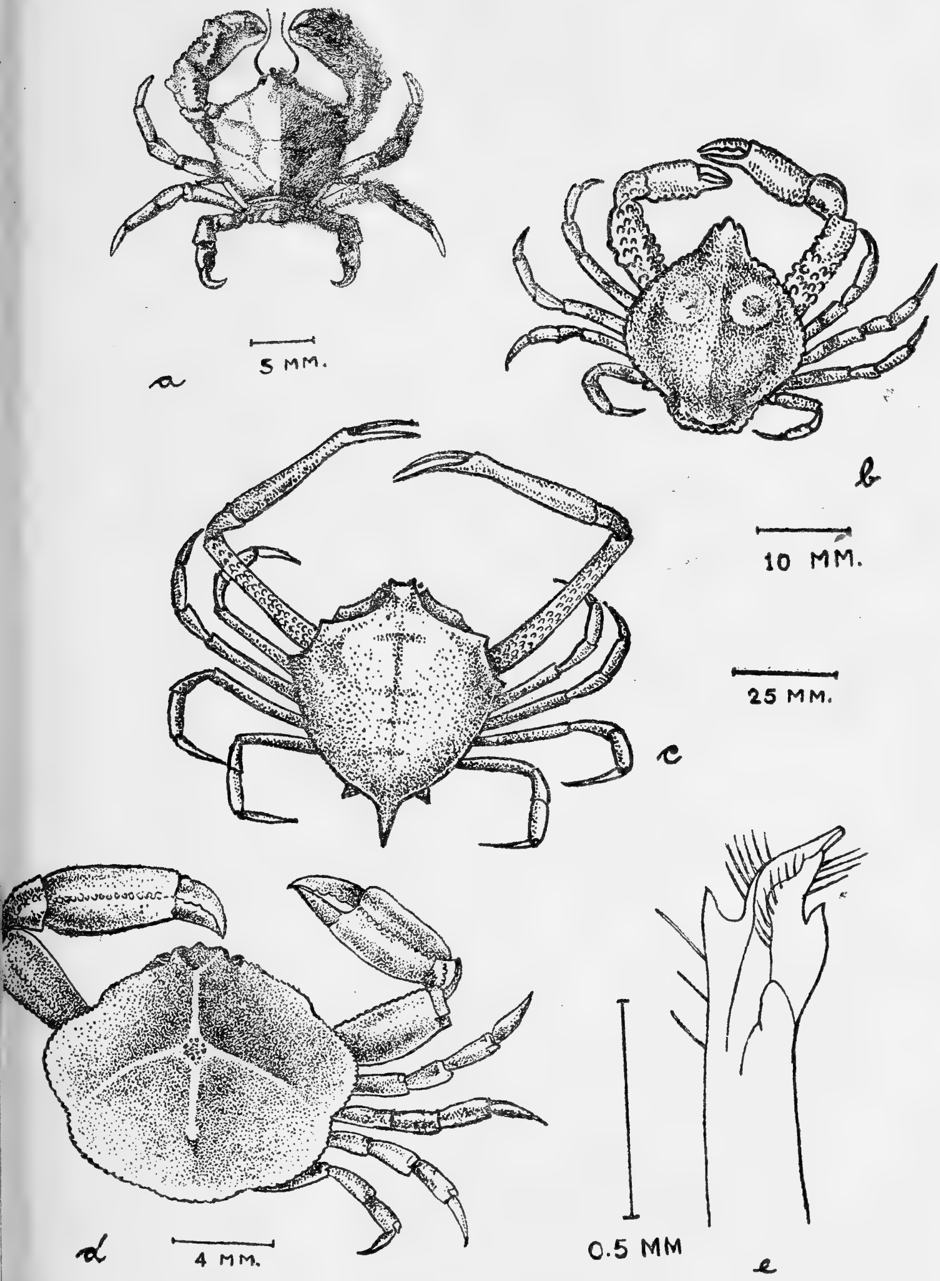
### **Nursia abbreviata** Bell

(Plate I)

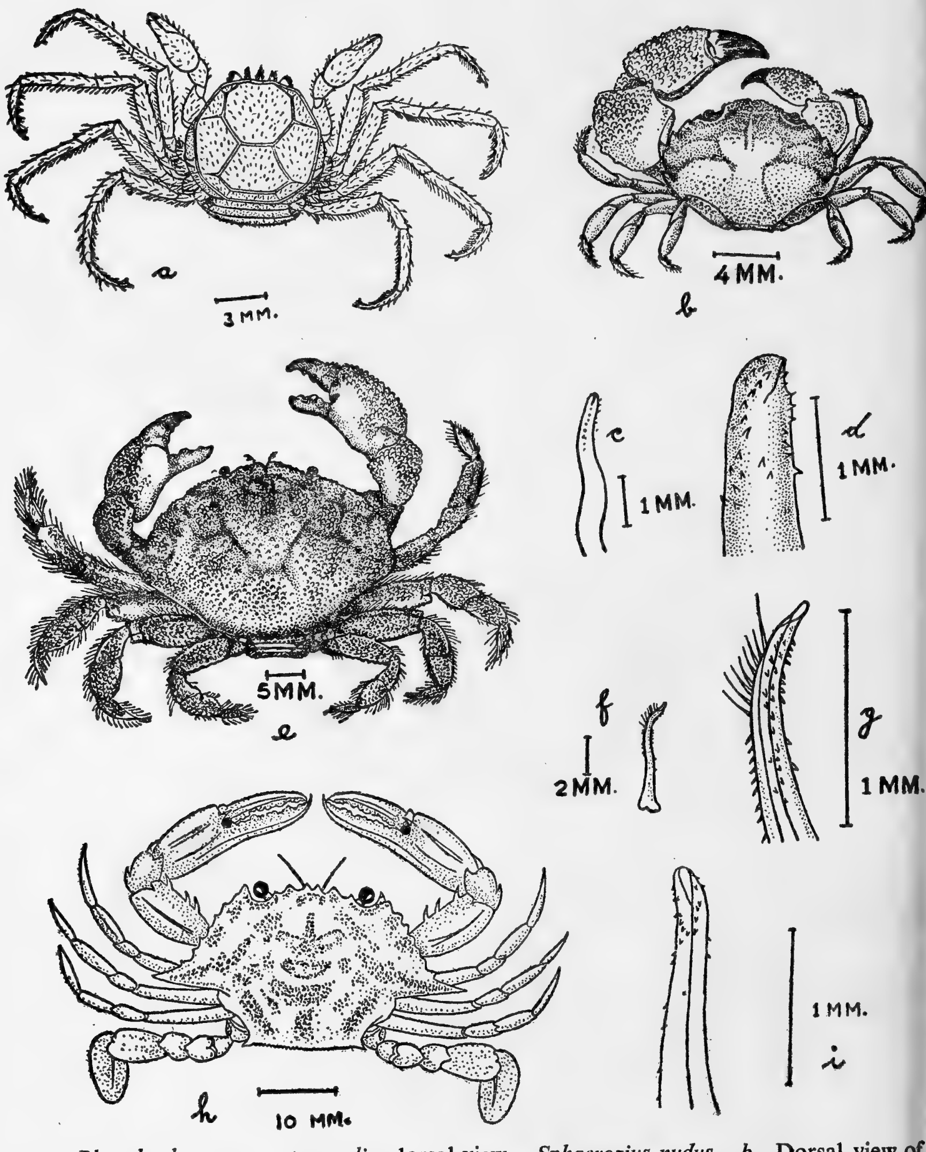
*Nursia abbreviata*, Bell, *Trans. Linn. Soc. London* (*Zool.*) **21** : 308 (1855) ; Alcock, *Journ. As. Soc. Bengal* **65** : 184 (1896).

Numerous specimens, of both sexes, were collected from Worli and Mahim (Bombay). A large male measures :—

| | | |
|---|---|---|
| length of carapace .. | .. | ..10 mm. |
| breadth of carapace | .. | ..12 mm. |




*a. Conchoecetes artificiosus*, dorsal view. *b. Leucosia longifrons*, dorsal view. *c. Myra fugax*, dorsal view. *Nursia abbreviata. d.* Dorsal view of crab. *e.* Tip of 1st left abdominal appendage of male.




*a*. *Rhynchoplax* prox. *octagonalis*, dorsal view. *Sphaerozius nudus*. *b*. Dorsal view of crab. *c*. 1st left abdominal appendage of male. *d*. Tip of same, enlarged. *Actaea obesa*. *e*. Dorsal view of crab. *f*. 1st left abdominal appendage of male. *g*. Tip of same, enlarged. *Portunus hastatoides*. *h*. Dorsal view of crab. *i*. Tip of 1st left abdominal appendage of male.

The carapace is depressed, with thin borders cut into seven lobes. It has only two ridges across it—one running laterally from border to border, and a longitudinal one from the front. The front is indistinctly tridentate.

The arm of the claws is trigonal, with granular edges. The wrist and hand have a dorsal beaded ridge.

The tip of the anterior male abdominal appendages is shaped like a trident.

This species has been previously recorded from Karachi, the Coromandel Coast, Gulf of Mannar, and Gulf of Martaban.

## Genus **Myra** Leach

### **Myra fugax** (Fabricius)

(Plate I)

*Leucosia fugax*, Fabricius, *Ent. Syst. Suppl.*: 351 (1798).

*Myra fugax*, Leach, *Zool. Miscell.* **3** : 24; Alcock, *Journ. As. Soc. Bengal* **65** : 202 (1896); Ihle, *Siboga Exped. Rep.* **39** : 256 (1918); Chopra, *Rec. Ind. Mus.* **35** : 39 (1933); Barnard, *Ann. S. Afr. Mus.* **38** : 373 (1950); Sankarankutty, *J. Mar. biol. Ass. India* **4**(1) : 154 (1962).

Numerous specimens, of both sexes, were obtained from trawl catches off Bombay in 25 fathoms. A large male measures :—

| | |
|---|---|
| length of carapace (without posterior spine) .. | 21 mm. |
| length of posterior spine .. .. .. | 8 mm. |
| breadth of carapace .. .. .. | 19 mm. |
| length of cheliped .. .. .. | 57 mm. |

The carapace is broadly oval, with three sharp spines—one at each end of the posterior border, and a long one in the middle line above the posterior border. The front is broadly bidentate. The carapace has a broad notch in the antero-lateral borders between the hepatic and branchial regions. The side-walls of the hepatic region form a facet, behind which the lateral borders are marked by a beaded line.

The anterior abdominal appendages are straight and end in a claw-like tip almost hidden in a brush of setae.

The chelipeds are long and slender. The hand is much longer than the fingers.

Colour pinkish.

Distribution: Indo-Pacific, from East Africa to Japan, Australia.

Tribe BRACHYGNATHA

Subtribe OXYRHYNCHA

Family *HYMENOSOMIDAE*

Genus **Rhynchoplax** Stimpson

**Rhynchoplax** prox. **octagonalis** Kemp

(Plate II)

*Rhynchoplax octagonalis*, Kemp, *Rec. Ind. Mus.* **13** : 256 (1917).

Two females from the crevices of a sponge were collected at Cuffe Parade, Bombay. The length of carapace of the larger one is 2·5 mm.

The specimens agree with Kemp's (1917) description of *R. octagonalis*, collected from Marmagoa, in the shape of the carapace and other general characters, but differ in the following characters :—

The long, sharp procurved tooth is situated between the bases of the first and second pairs of walking legs, rather than above the bases of the first leg. The walking legs are slenderer and less hirsute. The anterior border of their meri has no tooth. There is a stout recurved tooth close to the tip of the dactylus in the first pair of legs. Four minute denticles are present on the dactyli of the second and third pairs of legs.

**Elamena sindensis** Alcock

C. Sankarankutty, on page 347 of his paper ' On Decapoda Brachyura from the Gulf of Mannar and Palk Bay ', published along with the other papers read at the Symposium on Crustacea held by the Marine Biological Association of India in 1966, states *Elamena sindensis* to be a new record for the Indian region. It appears that he has not seen my paper published in this *Journal*, volume **55** (3), 1958, where I have described *E. sindensis* on page 582.

Subtribe BRACHYRHYNCHA

Family *PORTUNIDAE*

Subfamily LUPINAE

Genus **Portunus**

**Portunus hastatoides** Fabricius

(Plate II)

*Portunus hastatoides*, Fabricius, *Ent. Syst. Suppl.* 368 (1798).
*Neptunus* (*Hellenus*) *hastatoides*, Alcock, *Journ. As. Soc. Bengal* **68** : 38 (1899).
*Neptunus hastoides*, Chopra, *Rec. Ind. Mus.* **37** : 477 (1935).
*Hellenus hastatoides*, Barnard, *Ann. S. Afr. Mus.* **38** : 158 (1950).

Numerous specimens, of both sexes, were collected from trawl catches off Bombay in 25 fathoms. A large male measures :—

| | | |
|---|---|---|
| length of carapace | .. .. .. | 21 mm. |
| breadth of carapace (excluding lateral spines) | | 33 mm. |

The carapace is flat, the front being cut into four teeth. The antero-lateral borders are cut into nine teeth, the last being much longer than the others. The postero-lateral angles of the carapace are spiniform.

The hands of the chelipeds are almost as massive as the arms. There are two spines near the distal end of the posterior border of the arms. The distal half of the borders of the meropodites of the last pair of legs is finely serrulate.

The anterior abdominal appendage is abruptly bent in its distal half, with a few hairs near the tip.

Colour fleshy brown. There is a brownish black patch on the tips of the dactyli of the swimming legs.

This species occurs from Zanzibar to Japan, having also been recorded from the east coast of India and the Andaman Islands.

## Family *XANTHIDAE*

### Subfamily Menippinae

### Genus **Sphaerozius**

#### **Sphaerozius nudus** (Milne-Edwards)

(Plate II)

*Actumnus nudus,* Milne-Edwards, *Ann. Soc. Entomol. France* **7** : 265 (1867) ; de Man, *Journ. Linn. Soc. London (Zool.)* **22** : 49 (1887-88) ; Alcock, *Journ. As. Soc. Bengal* **67** : 207 (1898).

*Sphaerozius nudus,* Balss, *Rec. Ind. Mus.* **37** : 46 (1935).

Numerous specimens, of both sexes, were collected from the wreck of the S.S. *RAMDAS*, (which sank on the 17th July, 1947, with a loss of more than 700 lives) when it was salvaged on 1st April, 1957, and re-sunk off Butcher Island (Bombay harbour). A large male measures :—

| | | | |
|---|---|---|---|
| length of carapace .. | .. | .. | 9 mm. |
| breadth of carapace | .. | .. | 12 mm. |

This species is distinguished by the bare, convex carapace with four broadly triangular teeth on the antero-lateral borders, not including the outer angle of the orbit. There are two arched rows of pearly granules on either side of the gastric region.

The chelipeds are unequal, with the upper and outer surfaces of the wrist and hand studded with tubercles. The thumb has a broad tooth proximally.

Colour yellowish grey, fingers of chelipeds dark brown with white tips.

The anterior abdominal appendages are sinuous, with the truncate tip bearing numerous spinules.

Balss has discussed the systematic position of this crab.

This species has been previously recorded from Pondicherry, the Gulf of Mannar, and Mergui.

### Subfamily ACTAEINAE

### Genus **Actaea**

### **Actaea obesa** Milne-Edwards

(Plate II)

*Actaea obesa*, Milne-Edwards, *Nouv. Archiv. du Mus.* **1** : 272 (1865) ; Alcock, *Journ. As. Soc. Bengal* **67** : 145 (1898).

Numerous specimens, of both sexes, were collected from the wreck of the S.S. *RAMDAS*.

This species can be distinguished by the convex carapace being covered with granules, and not with tubercles. The areolation of the carapace is extremely faint anteriorly, due to the fineness of the grooves ; it is absent from the posterior third of the carapace. The lobulation of the antero-lateral borders is also indistinct, especially in the first lobe. The length of the carapace is slightly more than two-thirds its breadth. There are a few hairs on the carapace and legs.

| | |
|---|---|
| length of carapace .. .. .. | 12·5 mm. |
| breadth of carapace .. .. | 19·0 mm. |

The anterior abdominal appendages are arched, with a transparent horny tip. There are many recurved spinules and a few long hairs near the tip.

This species has been previously recorded from Bombay.

## Family *PINNOTHERIDAE*

### Subfamily XENOPHTHALMINAE

### Genus **Xenophthalmus** White

### **Xenophthalmus pinnotheroides** White

*Xenophthalmus pinnotheroides*, White, *Ann. Mag. nat. Hist.* **18** : 178 (1846) ; Henderson, *Trans. Linn. Soc. London (Zool.)* **5** : 394 (1893) ; Rathbun, *K. Dansk. Vid. Selsk. Skr.* **7**(5) : 338 (1910) ; Tesch, *Siboga Exped. Rep.* **39** : 272 (1918).
*Xenophthalmus pinnoteroides*, Alcock, *Journ. As. Soc. Bengal* **69** : 332 (1900).

Numerous specimens, of both sexes, were collected from Chowpatty, Bombay.

Anterior part of carapace and legs hairy. Carapace $1\frac{1}{2}$ times as broad as long. Epistome absent. Orbits are longitudinal slits, parallel to each other, in the carapace. Palp of external maxillipeds spirally twisted, rod-like, the propodite being at right angles to the carpopodite, and the dactylus being again perpendicular to the propodus.

Propodite of first pair of walking legs as broad as long, distorted—the originally ventral side being turned dorsally. Third pair of legs as long as, or longer than, twice the carapace length.

Anterior abdominal appendages long, obtuse at the tip, the latter with a group of slender spines.

Distribution : Hong Kong, Indonesia, Thailand.

I had given a key for the identification of the marine crabs of the (then) Bombay State, on pages 524-530 of volume **54**, no. 3, of this *Journal*. Additional records of crabs from Bombay, published by me since then, have necessitated modifications and/or additions to this key at various places. A revision is, therefore, attempted here. The numbers referred to in it are those found in the original key—new insertions being indicated by letters, so as to avoid confusion.

| | | |
|---|---|---|
| 6. | Merus of external maxillipeds more than half the length of the ischium measured along the inner border (Leucosiinae) .. .. | A |
| | Merus of external maxillipeds half or less than half the length of the ischium measured along the inner border (Iliinae) .. .. | *Arcania septemspinosa* |
| A. | Carapace convex, subcircular or oval .. .. .. | B |
| | Carapace broad and polygonal .. .. | *Nursia abbreviata* |
| B. | Chelipeds massive, posterior border of carapace smooth .. | C |
| | Chelipeds slender, posterior border of carapace with three petaloid spines .. .. .. .. .. | *Myra fugax* |
| C. | Front narrow. Exopodites of external maxillipeds narrow, with the outer margins straight (*Leucosia*) .. .. .. | D |
| | Front broad. Exopodites of external maxillipeds broad, their outer borders forming a semicircle (*Philyra*) .. .. .. | 9 |
| D. | Carapace much longer than broad.. .. .. .. | E |
| | Carapace as broad as long .. .. | *Leucosia sima* |
| E. | Thickened epimeral edge of carapace not visible in all its extent when viewed dorsally .. .. .. .. .. | F |
| | Thickened epimeral edge of carapace completely visible when viewed dorsally .. .. .. .. .. .. | G |
| F. | Outer edge of hand keeled .. .. | *Leucosia pallida* |
| | Outer edge of hand not keeled .. | *Leucosia longifrons neocaledonica* |

| | | |
|---|---|---|
| G. | Thoracic sinus deep .. .. .. | *Leucosia vittata* |
| | Thoracic sinus shallow .. .. | *Leucosia pubescens* |
| 11. | Last pair of legs shorter than the first two pairs .. .. | H |
| | Last pair of legs longer than the first two pairs.. | *Pseudodromia integrifrons* |
| H. | Carapace convex .. .. .. | *Dromia dormia* |
| | Carapace flat and pentagonal .. .. | *Conchoecetes artificiosus* |
| 13. | Carapace flat, weakly calcified. Male genital openings on last thoracic sternite (Hymenosomidae) .. .. .. .. | J |
| | Carapace not flat, strongly calcified. Male genital openings on fifth coxopodites .. .. .. .. .. | 14 |
| J. | Carapace with a honeycomb pattern .. | *Rhynchoplax octagonalis* |
| | Carapace without a honeycomb pattern (*Elamena*) .. .. | K |
| K. | Tips of dactyli of legs biunguiculate .. | *Elamena cristatipes* |
| | Tips of dactyli of legs triunguiculate .. | *Elamena sindensis* |
| 15. | Eyes without true orbits. Eyestalks very short or obsolescent, concealed beneath a supra-ocular spine or sunk in the sides of a large rostrum .. .. .. .. .. .. | L |
| | Orbits partly defined. Postocular process present, hollowed for the partial retraction of the short eyestalks (Pisinae) .. .. | 16 |
| | Orbits complete enough to entirely conceal the cornea dorsally .. | 17 |
| L. | Eyestalks long .. .. .. | *Achaeus lacertosus* |
| | Eyestalks short (Acanthonychinae) .. .. .. | M |
| M. | Rostrum simple .. .. .. | *Menaethius monoceros* |
| | Rostrum bifid .. .. .. | *Acanthonyx limbatus* |
| 22. | Teeth on antero-lateral borders equal in size.. .. | *Scylla serrata* |
| | Last tooth on antero-lateral borders enlarged in the form of a large spine (*Portunus*) .. .. .. .. .. | N |
| N. | Posterior angles of carapace rounded .. .. .. | 23 |
| | Posterior angles of carapace spiniform .. | *Portunus hastatoides* |
| 36. | Fingers of chelipeds with broad, hoof-like extremities | *Etisus laevimanus* |
| | Fingers of chelipeds pointed .. .. .. .. | P |
| P. | Carapace granulate .. .. .. | *Actaea obesa* |
| | Carapace tuberculate .. .. .. | *Actaea savignyi* |
| 42. | Basal antennal joint not reaching the front (Menippinae).. .. | Q |
| | Basal antennal joint broadly in contact with front .. .. | 43 |
| Q. | All the antero-lateral teeth broad, triangular.. | *Sphaerozius nudus* |
| | Anterior antero-lateral teeth broad, anteriorly acuminate, last one narrow and carinated .. .. | *Myomenippe hardwickii* |

47. Small crabs living as commensals, mostly in bivalve molluscs (Pinnotherinae) .. .. .. .. .. 48

Free living crabs .. .. .. .. .. R

R. The orbits are narrow chinks situated dorsally with their long axes at right angles to the anterior border of the carapace *Xenophthalmus pinnotheroides*

Orbits normal, transverse .. .. .. .. 49

54. Front 1/5th to 1/6th the greatest breadth of the carapace.. .. S

Front less than 1/15th the greatest breadth of the carapace .. 55

S. Two oblique granular ridges on the inner surface of the palm of the larger male cheliped.. .. .. *Gelasimus annulipes*

Only one oblique ridge on the inner surface of the palm of the larger male cheliped .. .. .. *Gelasimus inversus sindensis*

## Acknowledgements

The author is thankful to Dr. K. K. Tiwari, of the Zoological Survey of India, for confirmation of identification of some of the crabs, and to Dr. C. V. Kulkarni, Director, and Dr. H. G. Kewalramani, Senior Scientific Officer, Department of Fisheries, Maharashtra State, for critically going through the manuscript.

# Occurrence of *Spindasis abnormis* (Moore), (Lepidoptera: Lycaenidae) on the Western Ghats

## A revised Description, including Male Genitalia and Notes on early Development

BY

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(*With eight plates and two text-figures*)

Both sexes of *Spindasis abnormis* Moore are redescribed. Examination of male genitalia establishes this as a good species. The egg, and the egg-larva with its ant relationship, are described for the first time. Field notes are given on the biology of this butterfly. Much further research, especially of the early stages, ought to be undertaken.

### INTRODUCTION

Between 1951 and 1964 I was most fortunate in capturing nineteen examples of the rare butterfly *Spindasis abnormis* (M.), in two places on the Western Ghats, Maharashtra State. Previously there had been a total of only three males and six females available in the BM (NH), the Hope Department, Oxford, and the Bombay Natural History Society. This additional material, therefore, made possible a detailed review of the species. Mr. G. E. Tite has done dissections of the male genitalia, and with the generous permission of the authorities of the British Museum (Natural History) I am able to reproduce his drawings here. Mr. Tite's work, and that of Sir Keith Cantlie, seem to establish this *Spindasis* form as a good species. The egg has been found for the first time. Unhappily the resulting larva only survived a few days. It was of great interest, being attractive to ants from the first like the other members of the genus that have been studied. One hopes that this paper will help someone to work out the full life history.

### DESCRIPTION

Sir Keith Cantlie sent me a passage from De Niceville (1890 : 355) who quotes the original description by Moore of the male, made from

Bean : *Spindasis abnormis*

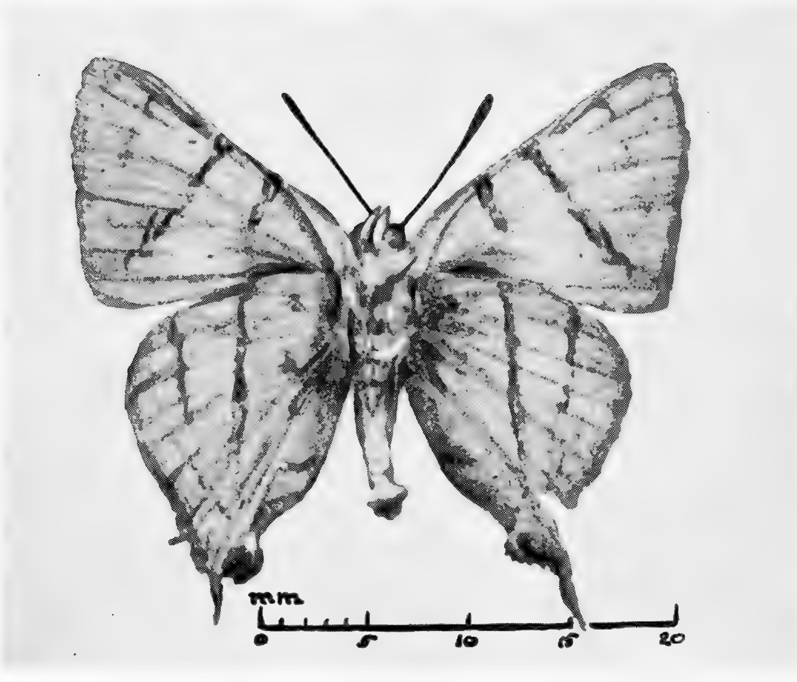

*Above :* Post-monsoon Male. Upperside showing clear shade on lower and central areas of forewing.

(*Photo : F. L. Wain*)

*Below :* Spring Male. Upperside showing dusting of light scales on forewing.

(*Photo : W. McM. Watt*)

Bean : *Spindasis abnormis*




*Above :* Post-monsoon Male. Underside showing complete markings.
(*Photo : F. L. Wain*)

*Below :* Spring Male showing reduced markings.
(*Photo : W. McM. Watt*)

what seems must be the type specimen now in the BM (NH)[1]. But in view of the material now available I venture to offer the following in greater detail : (See Plates I, II and IV for the male ; Plate III for the female).

MALE :

*Upperside.* Forewing, *c.* 15 mm., dusky violet brown. Spaces 1a, 1b, 2 base of 3 and lower part of cell between origins of v3 and v4 covered with scales of dull greenish blue, seen as shot with rich dark blue when held at a certain angle, and shining green at another angle. In DSF examples upf blue area may be sprinkled with light scales. In two examples (my S/Nos. 1745 and 1768) the irroration is very noticeable, largely obscuring the greenish blue, and so reducing the shot or shining colours at other angles. Dcv darkened. An obscure dark mark mid cell. Marginal line blackish brown, obscure but continuous. Cilia sullied white, hint of pale blue at tornus. Hindwing spaces 7 and 8 greyish brown, grading to a lighter shade towards the termen, often flushed with yellowish. Pre-costal cell bare, of a darker greyish brown. All cells, and spaces 1c to 6, overlaid by greenish blue scales, seen at different angles as on F. Spaces 1a and 1b ochreous, clothed with long white hairs. Marginal line as on F but obsolescent in 8 and 7, wider from 6 down. In one WSF example (my S/N 2210) there is an irregular ochreous brown border of approximately 1 mm., inside marginal line from apex to lobe. Lobe dull ochreous brown, with a few ochreous scales, anally dark brown to a variable extent prominently so in WSF examples. In most cases a very slight touch of silver on the lobe. Tail at v.1b, 3 mm., blackish, orange at base, white tip. Tail at v2, 1 mm., sprinkled with a few orange scales, white tip. Between tails the marginal line is indicated by a variable amount of dark brown sometimes touched with silver scales. Cilia greyish brown often variegated in shade, with a hint of light blue at the tornus.

*Underside.* Forewing light ochreous with scattered bluish-grey inconspicuous scales, but these are denser in spaces 1a and 1b. In DSF the ground colour shade appears paler and seems to have more red in it. Costa shaded brokenly blackish-brown from near base to apex. A sub-basal band of conjoined brown spots bearing silver spots from costa across cell terminating at origin of v2. A central band of conjoined brown spots bearing silver spots from mid-costa directed towards the tornus, ending at v1. Discal markings, a quadrate spot in 9 and 10, silver centred. Postdiscal markings, a striga from space 9 to 6, and another striga in 4. Submarginal markings, brown dots in 1b to 5, those in 4 and 5 slightly silvered, at least in the example S/N 2222 in coll.BNHS. This also has a query-shaped apical mark touched internally with silver in 6. The submarginal markings vary greatly and tend to obsolescence in the DSF. Some of the WSF examples, including that illustrated (Plate II, *above*) and the BNHS specimen more faintly, (Plate IV, *above*) show a double row of submarginal spots. A marginal line on termen, blackish brown, often ill-defined especially in DSF. Hindwing, ground colour as F. Obscure basal spots in 7 , cell, 2, and on v1a, often absent, even in WSF. A central band of narrow conjoined brown strigae, bearing silver spots, from mid-costa to v1 above the lobe of the tornus. A discal band of similar strigae bearing silver spots from costa to v4. A postdiscal band of brown strigae from v7 to v4, after which it becomes darker brown until it meets the central band and also a line in 1b above the lobe. Traces of a submarginal line in some specimens. A marginal line from v6 to v2. Tail at v1b, turning through yellow to blackish, white tipped. Tail at v2 blackish. The marginal line between the tails is indicated by a line broader and richer brown than the line between v6 and v2. A sparsely silvered patch above the marginal line between the

[1] Then known as *Aphnaeus abnormis* Moore. See Moore 1883, p. 526.

tails. Lobe ; greenish, dark blue and rich brown scales on a ground of yellow and pinkish. A small tuft on inner side of lobe. The description of the lobal area is made from the well-marked WSF, S/N 2222 in coll. BNHS (Plate IV, *above*); the markings here tend to complete obsolescence, especially in DSF. In 1b a chevron-shaped brown line with silver spots from the dorsum near v1a, ending not far from the central and postdiscal bands. The chevron points roughly to the junction of the central band with the costa. Cilia, greenish externally, then olive brown ; internally, at base, like ground colour of wings. *Antennae*. Club gradual. Above, club purplish, iridescent ; sheathed by shaft to expose 8 segments. Shaft inconspicuously annulated with white. Below, club velvety, light blue, sheathed by shaft to expose 10-11 segments. Shaft has chevron-shaped white marks at joints. *Thorax*, above purplish brown, darker than wings, iridescent. Scapular hairs light greenish-blue, pubescent. On segment 2 there are some longer and coarser white and whitish hairs, and more such on segment 3. Below, concolorous with wings. *Abdomen*, above purplish brown, some iridescent blue scales. At sides, reddish, this colour usually extending well up towards the dorsal surface. Below, as wings.

*Eyes and legs :* similar to those of other species of the genus.

**Male Genitalia** (See Plates V, VI, VII, and VIII.)

Mr. G. E. Tite writes : ' The *Spindasis abnormis* genitalia are, I find, a little difficult to draw in a way that shows clearly the various parts ; the valves are an amazing mixture of twists and curves, and the anellus is joined up with the valves by a quantity of diaphanous tissues, very difficult to see, and not possible to reproduce on paper. In order to overcome this I have made two preparations ; one is separated into three parts, the uncus, the aedeagus, and the valves with the saccus ; the other is kept intact '.

Mr. Tite's work on the genitalia seems to establish this as a good species, and that it cannot be an aberration of some *Spindasis* form as suggested, but without reasons given, by Evans (1932).

The nearest on genitalia to this species would, on general grounds, appear to be *Spindasis maximus* Elwes from Burma. When, however, the parts are dissected out the relative difference in each species of the size of the aedeagi as compared with the valves is striking. There are also the following clear differences.

| | *S. abnormis* | *S. maximus* |
|---|---|---|
| *Uncus :* | Central U-shaped gap narrow. | U-shaped gap much wider ; this could be due to pressure in dissection, but in Mr. Tite's opinion this was not so. |
| *Aedeagus :* | Bears a solid looking organ of cylindrical shape covered with blunt points. Length 2·29 mm. | No such organ, but an area in interior of vesica is covered with short, sharp spines. Length 2·36 mm. |
| *Valves :* | (*i*) Viewed from inside, as in plate VI(a), the outline from tip to ventral edge is sharply broken by a right-angled step. | (*i*) The outline referred to is continuous but slightly wavy. See plate VI (b). |
| | (*ii*) Dorsal edge of valve is at right angles to tip. | (*ii*) Dorsal edge of valve makes an S-shaped curve with the tip. |
| | (*iii*) The bridge connecting the valves inside has a narrow, deep U-shaped cleft. | (*iii*) The bridge has a wide U-shaped cleft. |

It seems to be characteristic of both *abnormis* and *maximus* that the tips of both uncus and valves are folded and twisted over in an intricate manner.[1]

FEMALE :

The following description is from my two females, S/Nos. 1496 and 1750, slightly expanded from De Niceville's description, (loc. cit. 355) :—

*Upperside :* forewing, 16-17 mm., WSF the smaller, shining plumbeous silvery. Dark ochreous brown border, widening on costa from about 1 mm. to about 2 mm. near apex. At apex about 4 mm., narrowing again towards anal angle which it just turns. Veins darkened by shade similar to that of border, especially in the WSF example. Darkening of dcv and mid-cell as male. Hindwing, below v6 of the same plumbeous silvery as F. Above v6, lightish ochreous, darkened towards bases of spaces 6 and 7. Precostal cell bare and darker. Dcv darkened, more broadly in the WSF example. Veins as on F. Marginal line easily seen, as no other border except obscure ochreous brown patch at apex. De Niceville's accurate description helped me to see that the lobes of my two females are slightly redder than those of the males. In the WSF example the colour of the lobes extends to near vla. In De Niceville's description there is a footnote that the silvery shade resembles that on the upperside of females of the forms now known as *Spindasis nipalicus* M. and *S. nipalicus sani* DeN. *Underside* as in male. Sides of abdomen ochreous, (cf. male).

EGG

The egg was light brown the day after being laid, and the next day turned darker. The empty egg shell, still in position on moss-covered bark, is mounted with S/N 1997 in my collection. In shape it is a sphere, flattened but not extremely, at the poles. Diameter 1 mm., depth, from ·5 to ·6 mm. These measurements include the surface sculpture. The depth cannot be given precisely, because of the hole in the top where the larva emerged.

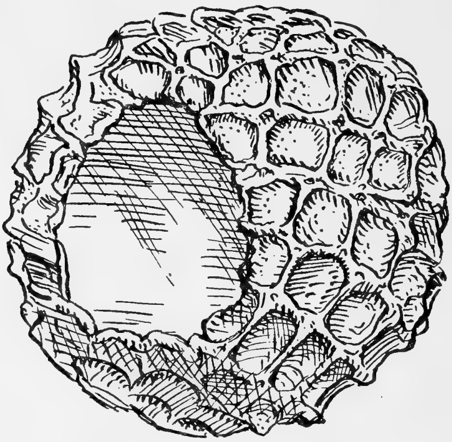
The surface of the egg is netted by cells of irregular squarish and hexagonal shapes. So far as can be seen the cells are roughly equal in area. However, the egg mentioned below (p. 626), is presumably of the same species and being unbroken it shows cells decreasing slightly towards the micropyle. The cell walls rise fairly sharply as shown at top left in Text-fig. 1. When looked at from above, with more or less top lighting, the cell walls seem band-like, as shown in the right central area in the figure. The junctions of the cell walls form slightly raised knobs many of which have a slight pit on top. The bottoms of the cells are shallowly scored by coarse, irregular pitting. The inside of the shell, seen through the emergence hole, is light brown and polished, showing at certain angles a beautiful green iridescence.

EGG-LARVA

On 3.iii.1964 the newly hatched larva had green mid-segments and was red elsewhere. A pair of permanently everted dorso-lateral organs were clearly seen on somite 8 of the abdomen. The head was always visible

[1] The BM/NH slides of *abnormis* are listed ' G. E. Tite, 1965-655 ' and ' 656 ' prepared from males in the coll. with my S. No. 1751 & 2307—A.E.B.

and never drawn into the first thoracic segment as in most Lycaenidae, and this is probably characteristic of the genus. From above, the sides



Text Fig. 1.

*Spindasis abnormis* M.
Egg shell (diagrammatic)

of the body were parallel. The whitish hairs which clothed the body were long and shiny.

On 6.iii.1964 the length was about 1·5 mm. and colour changes had occurred. The head was now dark brown, and as far as I could make out the thorax also. I noticed that the lateral hairs sloped towards the support. The larva was so closely appressed to its support that only the upperside could be examined, the sides being practically concealed.

While the larva was alive I failed to locate the exact position of the dorsal organ, and did not manage to see the ants drinking from it. I cannot at present detect it in the dead specimen either. It is probably hidden in a crease of somite 7, caused by the anal end turning up somewhat after death.

Also, I cannot now be sure of the exact location of the paired organs on somite 8 which were easy to see in life. In the figure I have indicated small processes which I believe to be these organs at either end of a kidney-shaped darkened area, representing what is apparently a hardened surface. I have not attempted to show all the abundant hairs, but have tried to show the club-like setae or tubercles which are present at the sides of somite 7 of the abdomen and 1 and 3 of the thorax.

Until more material is obtained it will probably be impossible to describe the larva more fully. A detailed description of the larva of *S. vulcanus* F. unsurpassed since, is in Bell (1919) : 473 ff.

DATA OF AVAILABLE MATERIAL

| *Collection* | *Sex* | *Locality & altitude* | *Date* | *Collector* |
|---|---|---|---|---|
| 1. BM(NH) | ♂ (type) e coll. Moore | Coonoor, Nilgiris | n.d. | Lindsay |
| 2. ,, | ♀ (type) | Nilgiris, 6200 ft. | n.d. | not given |
| 3. ,, | ♂ e coll. Watson | Nilgiris | n.d. | not given |
| 4. ,, | ♂ | Nilgiris | March, 1892 | not given |
| 5. ,, | ♂ (809) | W. Ghats *c.* 750 m. | 29-x-61 | A. E. Bean |
| 6. ,, | ♂ (810) | ,, *c.* 750 m. | 5-xi-61 | ,, |
| 7. Cantlie | ♂ (1489) | ,, ,, | 17-x-63 | ,, |
| 8. BM (NH) | ♂ (1745) | ,, ,, | 8-ii-64 | ,, |
| 9. ,, | ♂ (1751) | ,, ,, | 22-ii-64 | ,, |
| 10. ,, | ♂ (1752) | ,, ,, | 22-ii-64 | ,, |
| 11. ,, | ♂ (1749) | ,, ,, | 23-ii-64 | ,, |
| 12. ,, | ♂ (1765) | ,, ,, | 29-ii-64 | ,, |
| 13. Bean | ♂ (1766) | ,, ,, | 29-ii-64 | ,, |
| 14. BM(NH) | ♂ (1768) | ,, ,, | 29-ii-64 | ,, |
| 15. Hope Depart. in coll. H. C. & R. Winkworth | ♂ (1777) | ,, ,, | 29-ii-64 | ,, |
| 16. BM(NH) | ♂ (2209) | ,, ,, | 4-x-64 | ,, |
| 17. ,, | ♂ (2210) | ,, ,, | 4-x-64 | ,, |
| 18. Bombay NHS | ♂ (2222) | ,, ,, | 11-x-64 | ,, |
| 19. BM(NH) | ♂ (2289) | ,, ,, | 26-x-64 | ,, |
| 20. ,, | ♂ (2307) | ,, ,, | 27-x-64 | ,, |
| 21. ,, | ♀ | Nr. Poona, Purandhar | n.d. | Mrs. E. M. Harvey |
| 22. Bombay NHS | ♀ | Coonoor, Nilgiris | -iii-1927 | J. Florence |
| 23. ,, ,, | ♀ | Coonoor, Nilgiris | -iii-1927 | ,, |
| 24. Hope Depart. coll. H. C. & R. Winkworth | ♀ | Coonoor, Nilgiris | -iii-1932 | ,, |
| 25. BM(NH) | ♀ | Coonoor, Nilgiris | 16-iv-1934 | ,, |
| 26. ,, | ♀ (2498) | W. Ghats *c.* 1300 m. | 7/10-v-1951 | A. E. Bean |
| 27. Bean | ♀ (1496) | ,, 750 m. | 17-x-1963 | ,, |
| 28. BM(NH) | ♀ (1750) | ,, ,, | 23-ii-1964 | ,, |
| 29. Bean | ♂ (2663) | ,, ,, | 11-x-1966 | F. L. Wain |
| 30. Dept. of Entomology, Michigan State University | ♂ (2668) | ,, ,, | 15-i-1967 | A. E. Bean |
| 31. A. J. Sharman, A Dallington Green, Northampton, Eng. | ♂ (2675) | ,, ,, | 28-i-1967 | ,, |
| 32. Muséum National Paris | ♂ (2674) | ,, ,, | 28-i-1967 | ,, |
| 33. Bean | ♀ (2874) | ,, *c.* 1300 m. | 3-iv-1967 | ,, |

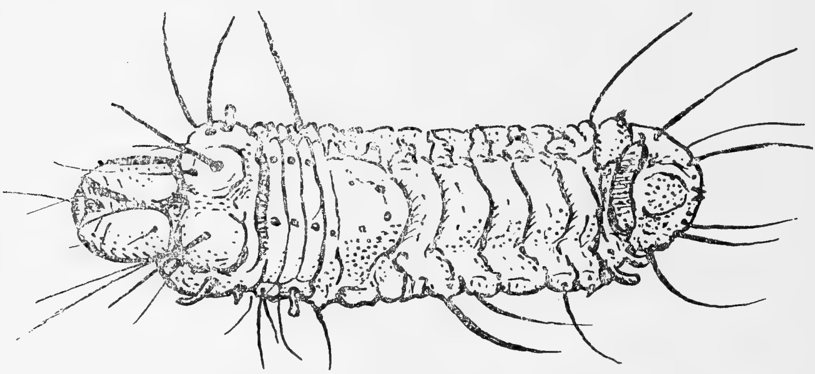
*Note* :—The female type in BM(NH), listed No. 2 above, is apparently that described by De Niceville (loc. cit., 355) 'from a single example in Mr. G. F. Hampson's collection'. Unfortunately this is not actually noted under the specimen.

## Field Observations

The following is based entirely on notes made while the facts were fresh in the mind ; it is hoped they are of some value in filling out the picture of this species in the field. The numbers given for reference below are the serial numbers from the first column of the above list. They are followed in brackets by the serial numbers on the data labels of my specimens.

26 (2498) is my first caught, and through inexperience not identified until 1957. It is a ragged female example taken at flowers of *Vitex negundo* Linn., which are especially attractive to Lycaenids and also to bees and wasps. It is the only one I found in the regions during the month of May.

5 and 6 (809 and 810) are males taken ' basking ' on leaves in the hot sun at about 14.00 hrs. They seem to have similar habits to male *S. lohita* M. which I found flying in the same favourite spots on this particular hill. They arrive as if from nowhere, dash back and forth and around the trees, and then may pitch suddenly on a leaf or else go off without settling. In this case one sat about twelve feet up a *Terminalia* tree, and the other on a low bush in the ' basking ' clump.

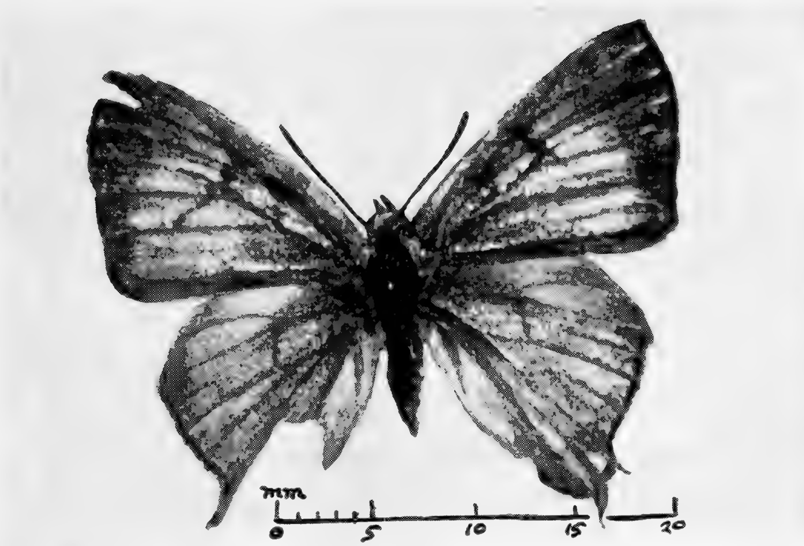


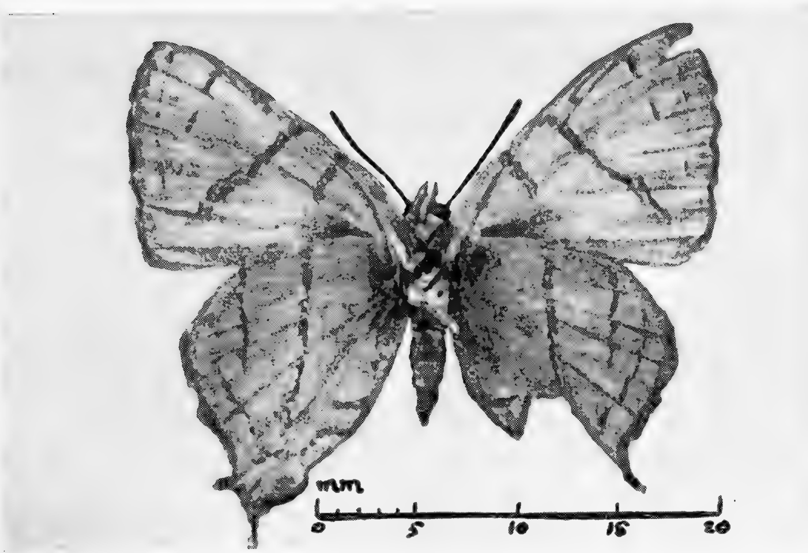
Text Fig. 2.

*Spindasis abnormis* M.
Egg larva × 50

All my males, about which there is nothing particular to say below, were caught ' basking '. My reason for inverted commas here is given below (p. 628) under Field work. They were often about 15-20 feet up, and hard to see because of the cryptic undersides, especially in the dry season against yellowing *Terminalia* leaves. Almost the only way of locating them is to try and follow their tantalizing preliminary dartings before they settle. They may, when really settled, open their wings displaying the shot blue as a stab of colour in the sunlight. **In this**

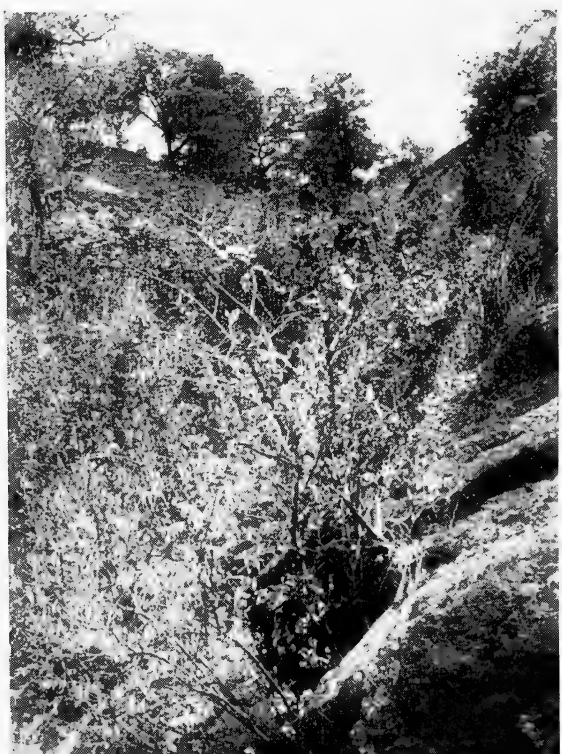
Bean : *Spindasis abnormis*




*Above :* Spring Female. Upperside ; *Below :* Underside.
(*Photos : W. McM. Watt*)

Bean : *Spindasis abnormis*



*Above :* Post-monsoon Male. Underside. Western Ghats, October 1964 ;
*Below :* Typical Ghat country.
(*Photos : W. McM. Watt*)

position the hind-wings are mostly covered by the forewings. When there is a good view of the underside one's excitement increases, for *abnormis* has a distinctive pale look below, quite unlike *lohita* with its broad sienna, almost crimson, strigae.

In connection with the male habit of ' basking ' the following is of interest : On 29.ii.1964 at about 15.30 hrs. I was about to leave the ground with one male secured, when another, and, as it turned out, at least two others arrived in quick succession and in a rather different manner from those observed when the sun was high. By this time most of the ' basking ' clump was in shadow on account of the hill summit behind me ; but the sun still lit up a four-foot *Randia* bush in front of the trees. The first arrival halted on the *Randia*. I could see it was *abnormis* and felt sure it would not stop long, so I disregarded the fear-some spines and made a stroke just above the insect, the only hope in the circumstances, and it worked. As soon as I was ready again another appeared, and I managed to get it in the same way. A third turned out to be unsuspecting, for though it left the bush while I was trying to aim, it settled in a much easier position on the *Jambul* behind. I have observed *S. lohita* behaving in the same kind of way as these *abnormis* in order to get the last of the sun. My impression was that they came from a roughly westerly direction, probably from the summit. [References are to 12 (1765), 13 (1766), 14 (1768) and 15 (1777)].

The WSF female, 27 (1496), was pointed out to me by my colleague Father Wain as it sat drinking from the flowers of *Celosia argentea* Linn. at about 13.00 hrs. The sky had clouded over from 11.00 hrs. and thunder was about.

The DSF butterflies also come to flowers ; I took the males 9 and 10 (1751) and (1752) at or around the flowers of *Colebrookia*, a scrubby plant with persistent flowerheads, very attractive to several kinds of Lycaenids during its short flowering season. When it was getting past its peak I took the male 12 (1765) nearby at flowers of *Zizyphus rugosa* Lamk.

In the fine weather after the monsoon of 1964 a specially interesting tree, *Dalbergia* came into flower, and was very attractive to Lycaenids for about five days. The male 20 (2307) came to this tree at about 11.00 hrs.; I have never seen an *abnormis* earlier in the day. *Spindasis vulcanus* F., and *S. lohita* also came to this *Dalbergia*, along with a female *Tajuria cippus* F., and both male and female *Anthene lycaenina lycaenina* Felder, in good numbers. This particular *Shisham* or Rosewood tree was growing on the side of a steep *nullah* where it would have got less attention from woodcutters and was able to flower.

**Egg laying**

On 22.ii.1964, I saw a female evidently egg-laying on a *Terminalia*

about ten feet from the ground. She was clinging to a small moss-covered side branch, from which there were lateral stems carrying leaf-buds about to open. She was well concealed by the underside pattern, but as she probed delicately about with her abdomen her perching angle changed somewhat and showed she was there. The movement would not have been likely to attract a bird or lizard, as it was very like that of an insecure leaf in the wind.

After about a minute she left the tree, fluttered around the *Colebrookia* without pausing for a drink, and made off. I wished her well, climbed the tree and cut off the small branch. But I could not find an egg on the leaf buds. I cut the buds off and took them to the house ; I scrutinized them outside and in, and still no egg. Next day I was able to return as it was Sunday afternoon. There was the branch, exactly where I had put it down when looking at the buds. There were the side shoots, with traces of the buds. And there, below the junction with the stem of one of these side shoots, was an egg on the bark among moss. I reflected that I might well have flung the branch from me instead of putting it down. As I had seen no *Spindasis* eggs of any kind before I was not prepared for looking at bark, though of course this is just where such great ant-lovers might be expected to lay. I report the circumstances, in no doubt myself that this was the egg I had watched an unmistakable *abnormis* laying the day before.

A week after this adventure I was again on the spot, and depressed to find the whole area had been burnt by grass cutters and several trees and much undergrowth were affected. After a long search I found an egg, apparently identical with that found on 22 March, on the same tree trunk. It was slightly marked, as if by fire, over the micropyle area and did not hatch. It is mounted in my collection, S/N 1998.

**Young larva, and ant relationship**

On 3.iii.1964, the larva emerged from the egg after an interval of nine days, which is exceptionally long for butterflies in the latitude ; I do not remember any of the admittedly few tropical Lycaenidae I have studied in the early stages taking more than three days. The larva emerged from the top of the egg and did not consume the rest of the shell.

The larva went readily to the young leaves of a *Terminalia*, taken from the tree on which it had been found. However, on no occasion did I actually see it eating these leaves, for it is not always so easy to make out what a tiny Lycaenid larva is doing. Quite probably, even if it did eat the leaves, it may have nibbled also the lichen on the stems provided and the moss from the stem on which the egg had been found. I had to use stems of *Terminalia* brought to Poona from the Ghats and kept in damp earth. In order to prevent the foodstuffs drying up I had to keep the larva in damp conditions also. In Poona, in March, this meant approxi-

mately airtight conditions, so I rigged a cage from a glass lamp chimney of moderate size, bedded in damp earth and closed at the top by a glass plate. The food kept fresh, there was not much condensation, and I do not think the well-being of the larva was affected.

I placed two *Cremastogaster* ants from the Poona garden into the cage. Immediately they began to fuss around the little larva. I was greatly relieved at this, for when getting the egg I had seen no ants on the tree trunk. Later I did find tiny ants everywhere on this trunk, but missed my opportunity of taking a sample.

The larva was very active for short periods. It evidently did eat the *Terminalia* leaves, making holes as far through as the lower epidermis. Since in the cage the leaves were not in position relative to the ground which they would have held when on the tree, it remains uncertain whether the larva ate from the surface which happened to be above, or always from the actual upper surface.[1]

After a period of activity it rested, either below a leaf or more often in a crack of the bark, where it was very hard to see. I observed it stayed in a crack for several hours. I kept thinking I had lost it, but learnt to look for the glint of the dorsal hairs.

4-iii. Towards evening the larva hid among moss on the bark, the drier of the two samples given.

5-iii. The larva was still on the bark, with the two ants continually moving around it and all over the stems. I noted that it seemed to be eating the dry moss. It looked healthy, and when it did decide to move, which was not often, it did so in a quick, determined manner, the very opposite of the sluggish behaviour of most Lycaenid larvae.

I became worried about the ants getting enough nourishment from the secretions of this tiny larva, so I supplied sugar solution, but did not notice them drink it. The ants remained in a state of such complete fascination by the larva that even when I was holding the stem and brushing them off while I looked for the larva they were most unwilling to leave.

The larva continued to be very difficult to locate, pressing itself right into the contours of the bark. Its colour and pattern were also highly protective, and being only about 2 mm. long, a strand of moss could hide it from view.

During the afternoon of this day the larva apparently settled down to change its first skin.

6. iii. I noted the changes in colour given above (p. 622). The ants were continually fussing around with waving antennae, even when the larva went under the moss in the early afternoon. I know now that I ought to have left it alone and not looked for it ; its presence during retirement for the moult was well indicated by the ants. However, the

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[1] I expect my observation is at fault ; see Bell's statement, in Hinton (1949).

fact is I looked for it again that evening, and placed it on an *Entada* leaf which I had added to the now not so fresh *Terminalia*. It ate some of this for there were droppings, and signs of eating on the originally whole leaflets of the *Entada*. Unfortunately the last of these moves and searchings must have resulted in injuring it. Next day I found it dead on the upper surface of the leaflet where it had rested the night before.

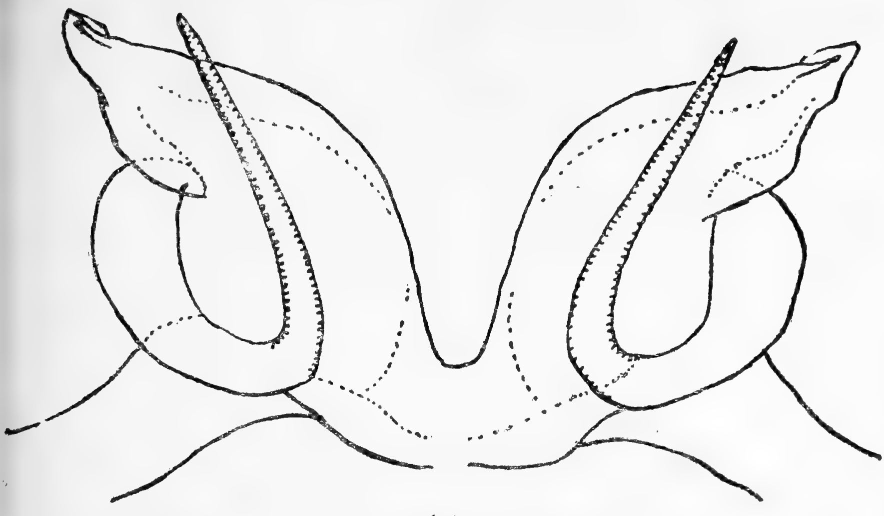
**Field Work**

The places where one encounters the *Spindasis* group are almost exclusively the tops of hills and lower eminences below the tops, where the males play and chase one another ; and at the flowers of some trees and herbs, where both sexes are seen. In Poona City and suburbs, for instance, one sees the species more characteristic of the plains, *S. vulcanus*, *S. ictis* Hew and *S. elima* M., coming to flowers, especially garden *Celosia* and others of that type, also *Poinsettia* and *Ageratum*. But for the true hill species, *S. lohita* and *S. abnormis* as well as other genera such as *Pratapa*, one must locate the ' basking ' trees. Otherwise one may tramp a long way on the hills without due reward.

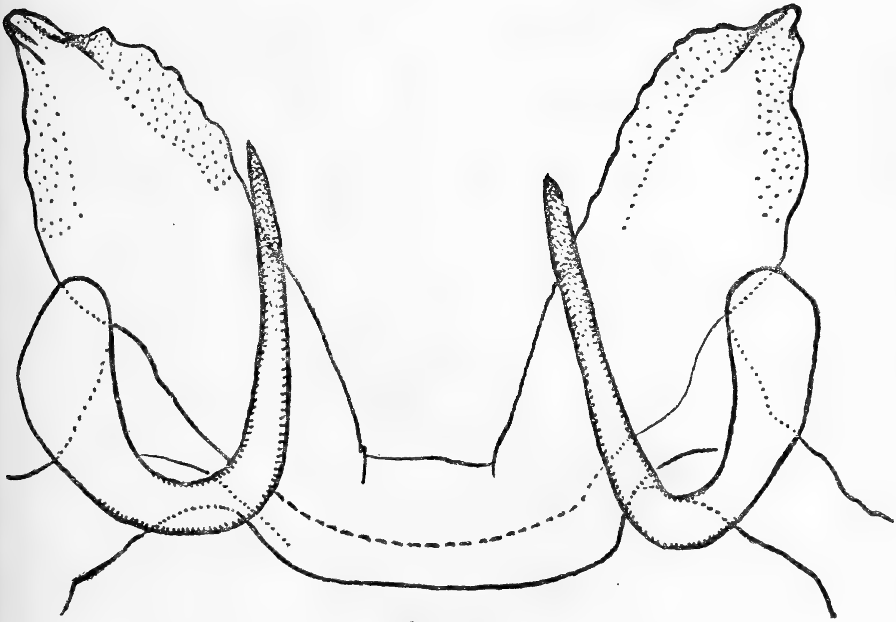
It is important also to carry extensions to one's net handle, however, *kutcha* as my apparatus certainly was, but it usually worked. I had three male bamboos each about 4′ 6″ long. I carried No. 1 in my left hand where it served also as a walking and steadying stick and yet did not prevent me from controlling the net-bag. The eighteen-inch net-handle had a ferrule to take the top end of No. 1. A suitable ferrule can be got from inside a cycle pedal. As necessary I could add Nos. 2 and 3, which had ferrules from old sea-fishing rods. I carried extensions 2 and 3 on slings over the shoulder ; I did not get into such a pickle as might be imagined.

The sort of place to look for is the head of a *nullah* on the hillside, from about 10.00 to 11.00 hrs. until 15.30 or so, according to the time of year. *Spindasis* do not seem to come early, but *Iraota*, *Pratapa* and *Zezius* do. These, and others, all like the breeze blowing up the *nullah*, which makes a chosen green leaf in the sunshine a pleasant place for an active butterfly to sit on, often with wings half open. I cannot call this basking in the strict sense. Lycaenid butterflies, anyway, do not stay long in scorching heat yet they often sit on a favourite perch for several minutes, even a quarter of an hour or longer. What I think they are enjoying is a cool vapour-bath ; the hot wind which tries the collector is tempered for the butterfly by passing through green leaves.

Nearly every *nullah* offering such conditions may have ' basking trees ' at its head, but one or two places on the hill will be found markedly popular with the butterflies, and used by their kind year after year. Male *Spindasis* only are found in this way, though of course when the food plant is near there is the chance of a female.



(*a*)

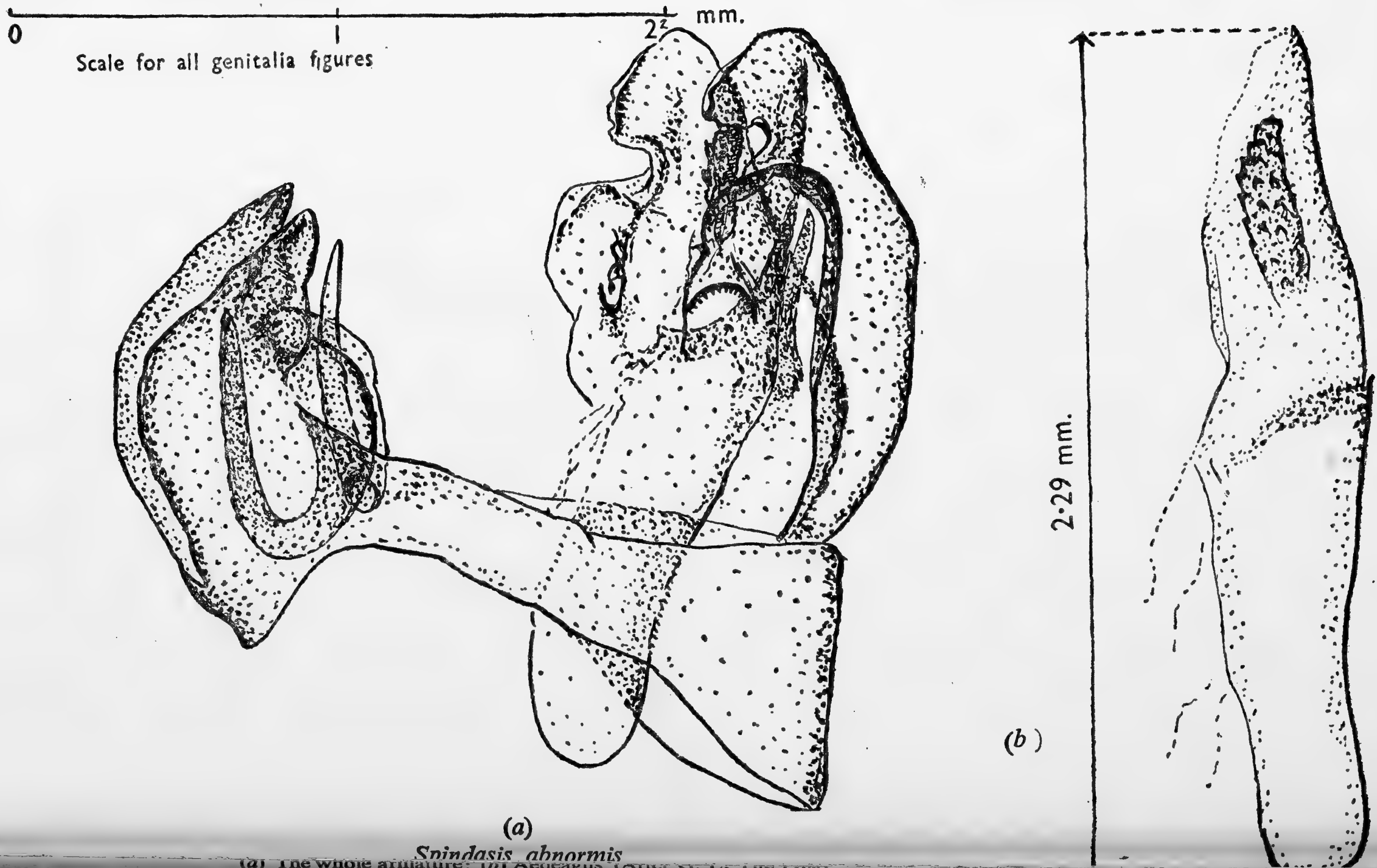


(*b*)

Uncus

(a) *Spindasis abnormis*; (b) *Spindasis maximus*

Bean : *Spindasis abnormis*




(*a*) (*b*)

*Spindasis abnormis*

(*a*) The whole armature; (*b*) Aedeagus

Of the two types of catching ground—hilltops and flowers—the latter are least profitable, no doubt because there are never a great many flowers of the right sort on the Ghats in their present denuded condition. A garden in or adjoining the jungle might be ideal, as for instance at Vihar and Kanheri near Bombay where I caught *S. lohita.* But for *S. abnormis* certain trees and clumps on the hills are the places to find.

## Conclusions

1. The material dissected by Mr. Tite shows that this is a good species by genitalia, which are unlike those of the other species of the genus. *S. maximus* is nearest by genitalia, but the resemblance is superficial. It is quite different by facies, and apparently by range.

2. *Spindasis abnormis* on the Western Ghats appears in a spring and summer, or ' dry season ' form, and in a post-monsoon or ' wet-season ' form. I looked for it without success throughout the colder months. I did not go up the hill during the rains, though I would have been ready to do so during the breaks which occur if I had not been occupied with *Nacaduba pactolus* elsewhere ; several workers are called for, especially when free time is limited.

The range of variation is similar to that of the rest of the genus, the WSF dark with clear markings, the DSF lighter and with obscure markings. The only striking difference from other *Spindasis* is the irroration of light scales on the forewings of some spring examples of the male. I do not know a parallel to this ; such colouring is usually seen in females, for instance those of *ictis* and *schistacea* M.[1] The female of *abnormis* is typically distinctive, and there does not appear to be much variation.

3. The first example from the Western Ghats is Mrs. Harvey's, listed no. 21 in the Table. When I learnt of her capture after identifying my own first specimen (No. 26, p. 623) I got the impression that the species is a high or medium level insect as in the Nilgiris. Thus Coonoor in the Nilgiris is just below the 2000 metre line, Purandhar on the Ghats reaches 1390 m., and my first locality is of a similar altitude. It was therefore interesting after 1960 to find the butterfly, at its most numerous so far, considerably lower down on the Ghats in a second locality.

4. It is a question whether *abnormis* has simply been overlooked in the spot where I found it not uncommon, or whether it is increasing throughout its range—so far as that is known. I would say it is quite likely to have been overlooked. In former days collectors in India tended to go to the Himalayas or the Nilgiris for leave ; where they went after butterflies in their usually scanty spare time apart from leave was

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[1] I have since received a ♂ *S. nipalicus nipalicus* M. from Mussoorie (May) which shows such an irroration.

largely a matter of chance and opportunity. Thus they may not have collected very often in the place I happened to be able to visit frequently.

If, on the other hand, there has been a general increase, one might be able to connect it with cyclic fluctuations over considerable periods. Obviously far more information is required, but it can be noted that the first unfortunately undated, material was probably taken about a century ago, when from the fewness of existing specimens it seems to have been a very great rarity.

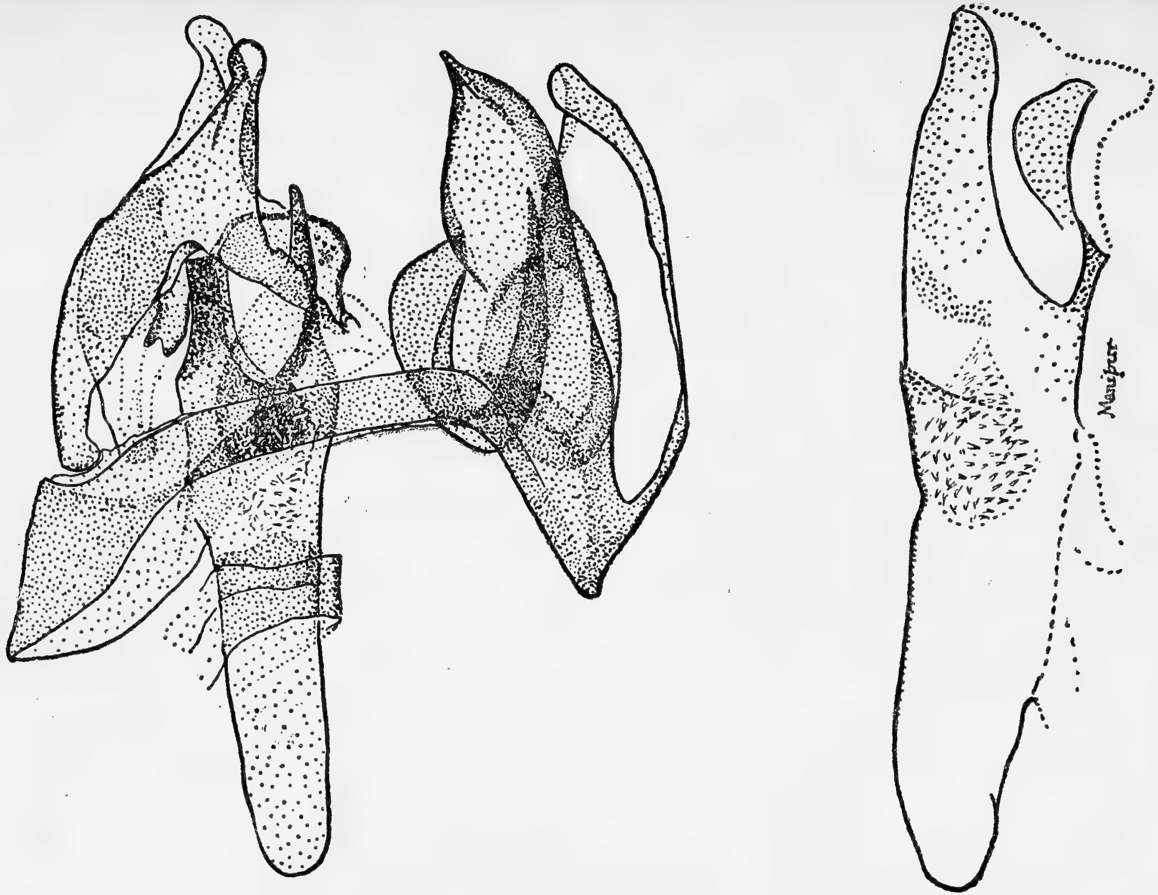
In either case information about status will be well worth obtaining. If anyone came across it in numbers, especially in a well demarcated area which the butterflies would not be likely to leave, a count should be made if at all possible. The method is described in Ford (1945, pp. 270-275) and consists of marking with cellulose paint and subsequently releasing a number of the insects. The proportion recaught on several successive days gives a mathematical basis for estimating the total population.

5. The early stages would be of the greatest interest if worked out. If I had another chance I would try and leave the larvae alone with their attendant ants on a growing seedling of the food plant. As long as the ants showed by their engrossed behaviour that the larvae were present I would try and restrain my curiosity about their progress while they were in hiding, at least until after successful rearings.

The following on two common species of the genus is quoted from Hinton (1949), p. 142 as it would help anyone who got larvae :

'The immature stages of several oriental species have been described by De Niceville (1890), and Bell (1919, **26** : 473-484). So far as known, the larvae are all attended by ants. They all at least in their later instars, have numerous setae with disc-like or star-shaped apices. The dorsal and lateral organs are always present. The lateral organs open at the end of short cylindrical tubes, and from the apices of these the usual membranous tube can be exserted. The ants attended the larvae as soon as the latter hatch, and the larvae appear to be dependent upon the ants to a considerable extent. *S. vulcanus* F. is attended by *Pheidole quadrispinosa* Jord. and *Cremastogaster* sp. When the larvae are partly grown they make little cells for themselves in any crevice or hollow they can find on the leaf surface, fastening the edges of the cell with silk and lining the inside thickly if somewhat slovenly (Bell). The cells are sometimes formed of two leaves spun together. These cells are more or less permanent, the larvae going outside to feed but being attended by the ants outside as well as in the cells. Sometimes several larvae of very different sizes will be found in the same cell (De Niceville). They feed on the undersides of the leaves, always leaving the upper cuticle intact even when they are full grown. The pupa is attached by both a cremaster and a girdle, usually inside the larval cell.

*Spindasis lohita* Horsf. is tended by *Cremastogaster* sp. which builds

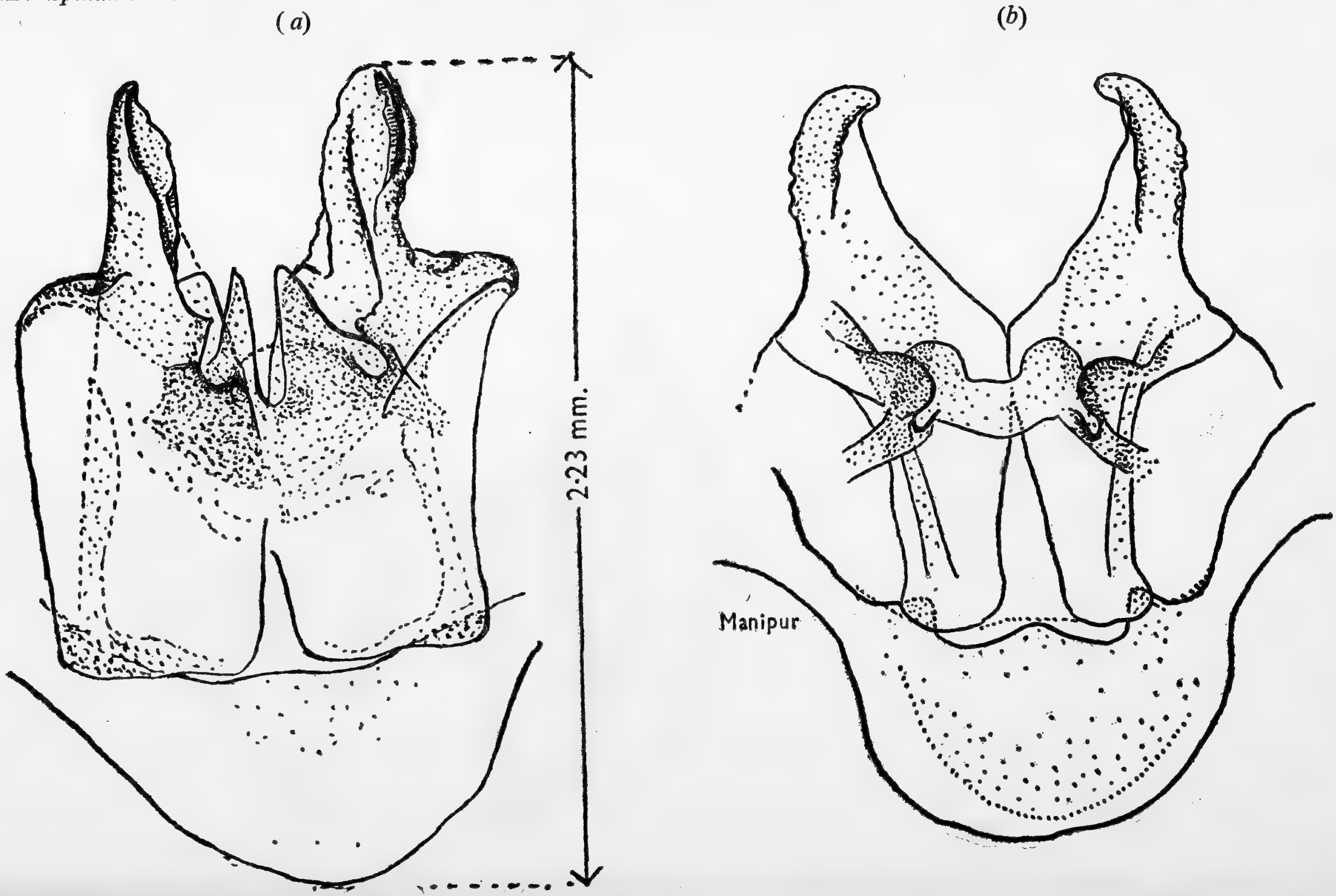



(*a*) (*b*)

*Spindasis maximus*

(*a*) The complete genital armature; (*b*) Aedeagus

Bean: *Spindasis abnormis*




**Valves**

(a) *Spindasis abnormis*, (b) *Spindasis maximus*

temporary sheds over them. Usually three or four larvae are in the same shelter. When young, they are found on dead, dry leaves on which they feed without damaging the upper cuticle, although if given young and tender leaves they will eat these. When the larvae are full grown, they make cells for themselves by loosely spinning the edges of a leaf together. Green (1902) found that in Ceylon the larvae lived on *Acacia* and *Grevillea* in special shelters built by *Cremastogaster.* The ants drove them out each night to feed and brought them back into their shelters each morning. The larvae may pupate in their shelters or in some crevice. The pupa is attached only by a cremaster.'

6. I have noticed that the butterflies of the genus, which I have only observed in Maharashtra, appear at fairly well marked periods ; spring, hot weather, rains and autumn. It looks as if they are able to key-in their metamorphosis with the ant situation and perhaps with the plant-life too. They may delay their development in any of the stages, even the egg, as observed in this single case of *S. abnormis.* If such delay is normal I can think of no other reason except the need of desirability of the seasonal generations being well marked.

7. It is when one has the privilege of encountering a very rare butterfly that one realizes the gaps in one's knowledge of the daily routine even of common ones, particularly lycaenids. Their occupations consist, no doubt, of sleeping, drinking, playing—often with pugnacity—, courtship, mating and egg-laying. Of these six or seven activities I only know anything about two—drinking and playing—in the case of *S. vulcanus* and *S. lohita* which occur commonly on the same hill as *S. abnormis.* If they had been rare I should undoubtedly have gathered more information.

There is some excuse, for time is a great factor, and the work always takes far more time than one can give. The solution is, of course, to have more workers on the same specialized line. Moreover, field observation is intrinsically more difficult than with larger animals ; where butterflies—particularly small, quick ones like Lycaenids—are concerned and what they are doing at any moment, are problems which must often remain a mystery. Anyone who has gone after them knows that they arrive and are off, and field observation has to be curtailed by the necessity of catching a reasonable number. Still, I am glad to have spared an egg-laying *abnormis* ; I hope I would always do so, for they can usually be recognized without catching.

Finally, I hope that the peculiar difficulties in the field study of the fascinating Lycaenid group will spur others, on as difficulties ought to do. I am unlikely ever to be able to revisit India[1]; this makes me all the

[1] But I had a short happy visit in 1967—AEB.

more ready to give exact local information, through the Bombay Natural History Society, to anyone who intends to work out more completely the life history of *Spindasis abnormis*.


## Acknowledgements

I thank Sir Keith Cantlie for much good advice throughout, and in particular for condensing and clarifying my descriptions of the adult insect. I found his note (1963) very helpful in introducing me to the male genitalia of the genus. The authorities of the BM (NH) allowed Mr. G. E. Tite to make dissections and drawings of *S. abnormis* and *S. maximus* male genitalia. I am extremely grateful for their permission to reproduce them here, adding considerable importance to this article. I would like to thank Mr. Tite himself for his beautiful work and for the passage quoted on p. 5, from one of his letters to me. He was most illuminating in his quite considerable correspondence on the subject, without which I could not have written the section on genitalia. Col. C. Cowan helped much in obtaining exact data from the BM (NH) material in the Zoological Museum, Tring, where the Lycaenidae are housed. I owe a great debt of gratitude to the Curator and Staff of the Bombay Natural History Society for every facility and encouragement ; and similarly to the Hope Professor of Entomology, Oxford, and his Staff, especially to Mr. D. Whiteley and Mr. I. Lansbury, the last named measuring the egg for me. I thank the Rev. W. McM. Watt, and my colleague, the Rev. Father F. L. Wain, for the excellent photographs. The latter, as always, helped me by encouragement and advice under a variety of circumstances, not least in many happy days on the magnificent hills of India. I thank Mr. N. D. Riley of the BM (NH) for confirming my identifications of the first three specimens of *S. abnormis* specimens caught.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# A Report on Wild Life Surveys in South and West India

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BY

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(*With four plates and two maps*)

[*Continued from Vol.* **65** (2): 325]

## Wild Life Sanctuaries in Madras State [1]



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TABLES AND MAPS



## I. THE MUDUMALAI WILD LIFE SANCTUARY

### INTRODUCTION

I arrived at the Abhayaranyam Forest Rest House in the Mudumalai Wild Life Sanctuary, from Bandipur, on the morning of November 30, 1966. Bandipur, in the Venu Gopal Wild Life Park in Mysore, is 10 miles from Abhayaranyam.

The 125-square-mile Mudumalai Wild Life Sanctuary in the north-western corner of the State is the largest and best known sanctuary in Madras. It is located in the Gudalur Division of the Nilgiri District and borders both the States of Mysore and Kerala (Map 1). The tri-state area including the Mudumalai Sanctuary, the adjoining Bandipur Sanctuary in the Venu Gopal Wild Life Park of Mysore, and a wild life area in Kerala, which has been proposed as a wild life sanctuary, comprises the most complete ecological unit dedicated to the preservation of wild life in India.

In 1940 a 23-square-mile sanctuary, adjoining an area in Mysore State which was constituted as the Bandipur Sanctuary in 1941, was established as the Mudumalai Wild Life Sanctuary—the first true wild life sanctuary in Madras State. The sanctuary was extended to 114 square miles in 1956 and an additional 11 square miles have since been included.

Mudumalai includes the Mudumalai and Segur ranges of the Nilgiri Division. A Range Officer from the State Wild Life Organization is assigned to each of these ranges. A third Range Officer is in charge of statistics and wild life studies within the sanctuary. Additional personnel assigned to the sanctuary from the State Wild Life Organization include : a clerk, three peons, ten Forest Guards, 18 Forest Watchers, a Watcher-cum-Cook and a sweeper. These men are charged with the responsibility of protecting the sanctuary's wild life, attending or assisting visitors, and maintaining the sanctuary's interior roads, salt licks, observation towers and other facilities. In addition to the sanctuary's wild life staff, regular Forest Department personnel, including two terri-

torial Range Officers, are in charge of all forest operations within the sanctuary. Mudumalai also is composed of several forest blocks. The centrally located Mudumalai and Teppakadu Blocks, the Benne Block on the western end of the sanctuary adjoining Kerala, and the Moyar Block on the eastern end adjoining Mysore are the main wild life areas.

The dense forests and luxuriant vegetation in most of Mudumalai contrast markedly with the dry deciduous forests of the adjoining Venu Gopal Wild Life Park. Much of Mudumalai receives between 50 and 80 inches of rainfall per year as compared to about 35 inches in Venu Gopal. The verdant vegetation of Mudumalai presents a more varied habitat for wild life than the open forests of Venu Gopal, but the thick undergrowth also makes wild life observation or photography much more difficult. The Moyar River, which forms the natural boundary between Madras and Mysore States, is the most important source of water in the sanctuary. There are a number of other streams, but most of these, such as the Kakkanahalla and Avarahalla, dry up during the summer.

## Visitor Facilities

Visitors to the Mudumalai Sanctuary are requested first to check with the Range Officer at the sanctuary's headquarters in Kargudi. Kargudi is along the main Ootacamund-Mysore road, 40 miles from Ooty and 60 miles from Mysore. The Mysore-Madras State border is five miles to the north-west and Bandipur, the headquarters for the Venu Gopal Wild Life Park, an additional five miles to the north (Map 2). Daily bus services between Ooty and Mysore pass through the sanctuary and upon request will stop at Kargudi or the nearby Abhayaranyam Forest Rest House. The nearest railway station is at Ooty and the nearest airport is at Coimbatore, 52 miles south-east of Ooty.

There are 45 miles of fair-weather roads within the sanctuary, along which motoring may be done except during the rainy season. The Forest Department provides a truck to take visitors around the sanctuary. An 18 passenger bus also was purchased in 1966 for visitor use, but a number of the sanctuary's roads must be widened before it may be used on them. Six machans or observation towers have been built at salient points overlooking salt licks and water holes. Visitors may remain in these and observe wild life in relative comfort. However, the best manner in which to view wild life in Mudumalai is from elephant back. Riding elephants from the elephant camp about one and one-half miles east of Abhayaranyam are provided for visitors upon prior request. With care, visitors on elephant back may approach near to herds of gaur and other wild animals without disturbing them.

There are three Forest Rest Houses in Mudumalai : Abhayaranyam, Kargudi and Masinigudi. All provide modern amenities, including refrigerators and catering. A cook is attached to each and both vegetarian and non-vegetarian meals are served. However, for prolonged visits it is suggested that visitors bring their own provisions. Reservations for accommodation and food, as well as elephant rides or transportation within the sanctuary, may be made through either the Divisional Forest Officer in Ootacamund or the State Wild Life Officer, c/o Chief Conservator of Forests, Central Office Buildings, 81 Mount Road, Madras-6.

The Abhayaranyam Forest Rest House is located along the main Ootacamund-Mysore road about one-half a mile west of the sanctuary headquarters at Kargudi. It is the most modern of the sanctuary's rest houses and even has a darkroom for the use of camera enthusiasts. Two double suites are provided which will accommodate a total of five people. The present cook and caretaker is exceptional and the food and services excellent. The Kargudi Forest Rest House is situated on the crest of a hill a little over one-half a mile north of the sanctuary headquarters. It has a beautiful sylvan setting and provides a good view of much of the sanctuary. Two large double suites, which may accommodate up to three persons each, and an extra bedroom are provided here. It belongs to forest operators of the Forest Department rather than to the wild life organization as does Abhayaranyam. The Masinigudi Forest Rest House is located on the eastern end of the sanctuary. This rest house has three suites. Although it is well-maintained, it is located near a fairly large village and does not provide the atmosphere of the Kargudi or Abhayaranyam rest houses.

Plans have been submitted and accepted by the State Wild Life Organization for the construction of a ten-room dormitory, and the estimated cost is Rs. 50,000. Construction is to be completed in 1968.

The proposed rest house is much needed for the ever-increasing numbers of visitors to the Mudumalai Sanctuary. With their completion and the availability of accommodation for large groups or regularly scheduled tours, the number of visitors should increase even more rapidly. A total of only 640 visitors were recorded for Mudumalai in 1960. However, by 1965 the number was almost 4000, an increase of well over 600 per cent. Likewise, only 18 foreign visitors were recorded in 1960, but a total of almost 600 in 1964. The total number of visitors to the sanctuary between 1960 and June 1966, as reported by the Forest Department, was 17,656 including 1578 foreign visitors. When transportation and other expenses incurred in travelling are considered, to and from the sanctuary as well as expenditures for food and other facilities within the sanctuary, the revenue realized by the State and Nation from the Mudumalai Sanctuary is considerable. Conservatively estimated, the

Segur River Falls near the western boundary of the Mudumalai Wild Life Sanctuary.

(*Photo : J. J. Spillett*)

Spillett : Wild Life Surveys

*Above :* Chital near the Abhayaranyam Forest Rest House, Mudumalai Wild Life Sanctuary.

(*Photo : J. J. Spillett*)

*Below :* The Gaur or Indian "Bison", a common inhabitant of the Mudumalai Sanctuary.

(*Photo : M. A. Badshah*)

current revenue from Mudumalai's wild life probably exceeds Rs. 4 lakhs per annum. Further, this is realized with very little capital investment and represents only a small portion of the sanctuary's potential as a revenue earner.

## Habitat

The Mudumalai Sanctuary consists primarily of undulating forest-covered hills nestled at the base of the Nilgiri Hills. The Nilgiris attain a height of 8000 feet and form the skyline to the south and west of the sanctuary. The altitude of the Mudumalai Sanctuary varies between 3000 and 3800 feet (914-1158 m.) above sea-level.

The overall average annual rainfall is approximately 56 inches (1422 mm.), although rainfall varies greatly in different parts of the sanctuary. For example, much of the Benne Block receives about 80 inches of rainfall per year, most of which falls during the south-west monsoon between June and September. Kargudi, on the south-eastern side of the Mudumalai Block, receives an average of about 50 inches per annum. The Moyar Reserve, however, receives only about 35 inches per year. And, most of the rainfall in the eastern part of the sanctuary falls during the north-east monsoon between October and December. Therefore, as would be expected, the vegetation likewise varies greatly in different parts of Mudumalai.

December and January are the coldest months. Monthly minimum and maximum mean temperatures for these months are respectively 55° F. (12·8° C.) and 70° F. (21·1° C.). The hottest months are April, May, and June, prior to the onset of the south-west monsoon rains. Monthly maximum and minimum mean temperatures for these months are respectively 90° F. (32·2° C.) and 75° F. (23·9° C.).

February, March and April are the driest months, although the dry season for most of the sanctuary extends from October until late June. The sanctuary staff burn the dry grass and undergrowth each year between December and January, along block lines, fire lines, State boundary, and around residential buildings. This improves visibility and permits the growth of succulent vegetation. Therefore, the best time to observe wild animals in Mudumalai is between mid-February and late June. In contrast, the best time to observe wild animals in the adjoining Venu Gopal Park is between June and October, during the rainy season. The vegetation in Mudumalai, however, is greener and presents a more tropical luxuriance in October and November. This is pleasing to the eye, but also it is discouraging not to be able to observe the wild animals.

The entire sanctuary is exploited for forest produce. There are a number of teak plantations, primarily in the Benne Block, and a plan-

tation of *Eucalyptus* in the Masinigudi area in the eastern part of the sanctuary. The planting of bamboo for the rayon mills in Kerala also has gained prominence during the past five years. Bamboo shoots are planted at 39-feet intervals and the plantings have a three-year rotation period. Such plantings probably are beneficial for gaur and elephant, as well as other wild animals that feed extensively upon bamboo.

The major part of the sanctuary still consists of more-or-less natural forests. All, however, are worked intensively for forest produce. Timber extraction includes both clear felling and selective cutting. Exploitation of minor forest produce is likewise of importance in the sanctuary. This includes the collection of wild honey, antlers, *poocha-kottai* or soap nut (*Sapindus emarginata*), a type of moss used as a food condiment, gallnut for medicinal use from *Terminalia chebula* and *T. belerica*, and edible fruits from such trees as the tamarind (*Tamarindus indica*). Kurumbars, tribal hill people, collect most of the minor forest produce through the Co-operative Department and under lease from the Forest Department. Kurumbars also comprise most of the labour force employed by the Forest Department at Mudumalai. With the exception of the Moyar Block at the eastern end, domestic livestock grazing inside the sanctuary consists of about 200 animals belonging to employees, such as the Kurumbars.

**Flora**

The flora of Mudumalai is noticeably varied in different parts of the sanctuary. Generally speaking, the forests vary from dry deciduous scrub on the eastern end to dry deciduous and then moist deciduous with more and more intermingled evergreen species as one progresses further west. There are also a fair number of swampy areas in the northern part of the sanctuary.

The tree growth in the Masinigudi area on the eastern end is stunted, with thorny undergrowth and short grass. Species of *Acacia* and *Albizzia* predominate in this section. The scrublands merge into relatively open dry deciduous forests with somewhat stunted trees of such species as *Shorea talura* and *Anogeissus latifolia* as well as species of *Acacia* and *Albizzia*.

The forests of the Mudumalai Block also are deciduous. However, they grade from dry deciduous into primarily moist deciduous forests. Here the trees attain impressive heights and the undergrowth is much more dense. Ferns, vines and rank grasses are common. Characteristic tree species include : *Terminalia tomentosa*, *T. belerica*, *T. chebula*, *Anogeissus latifolia*, *Schleichera oleosa*, *Gmelina arborea*, *Lagerstroemia lanceolata*, *Pterocarpus marsupium* and so forth. Dwarf date palms (*Phoenix acaulis*) predominate in some forest belts and in the vicinity of the swampy areas near the Madras-Kerala border.

The Benne Block consists of an admixture of evergreen and moist deciduous forests. Big Bamboo (*Bambusa arundinacea*) is common throughout the sanctuary wherever there is sufficient moisture. According to M. Krishnan, the bamboo flowered gregariously in 1959 in the Benne Block. Some of the bamboo along the Madras-Mysore boundary also flowered in 1964, as did most of the big and small bamboo in the adjoining Venu Gopal Wild Life Park. However, most of the bamboo inside the sanctuary appears to have completely regenerated and gives many of the forests a luxuriant light-green appearance.

Roughly two-thirds of the forests of the Mudumalai Sanctuary are moist deciduous. The other one-third is primarily dry deciduous. An overall estimate of the per cent composition of the dominant species in the moist deciduous forests of the sanctuary is given in Table 1.

The flowering of many of the forest trees in Mudumalai takes place about March.

TABLE 1

DOMINANT PLANT SPECIES OF THE MOIST DECIDUOUS FORESTS OF THE MUDUMALAI WILD LIFE SANCTUARY IN MADRAS STATE

| English | Tamil | Scientific | Estimated per cent of Stand |
|---|---|---|---|
| *TREES OR CANOPY*: | | | |
| Teak | Thekku | *Tectona grandis* | 20 |
| Laurel | Mathi (Kanarese), Karimarudu | *Terminalia tomentosa* | 10-15 |
| Axlewood | Namai | *Anogeissus latifolia* | 15 |
| Rosewood | Eetti | *Dalbergia latifolia* | 10 |
| Ven-teak | Venthekku | *Lagerstroemia lanceolata* | 10 |
| ——— | Vendai | *Kydia calycina* | 5 |
| Other Tree Species | — | — | 10 |
| Big Bamboo | Perumoongil | *Bambusa arundinacea* | 15 |
| *SHRUBS*: | | | |
| Lantana | Oonichedi | *Lantana camara* | very common |
| Indian Laburnum | Konnai | *Cassia fistula* | common |

**Fauna**

The fauna of the Mudumalai Wild Life Sanctuary is both varied and abundant. Perhaps nowhere else in India may greater numbers of chital or spotted deer (Plate II) be observed than in the Masinigudi area on the eastern end of the sanctuary. Visitors may observe as many as 2000 deer while motoring along the roads of this area during the morning or evening. As a rule the animals are in groups of more than 30, and herds of over 100 are not unusual, except during the dry season (January-June) when they are scattered in small groups. One of the Range Officers stated that on several occasions he has observed that the much maligned Indian wild dog or dhole is afraid of large groups of chital, as well as of

man. They only attack small groups or solitary animals. Further, he claims he twice observed chital being pursued by wild dogs which came close to and stood by humans until the wild dogs had gone.

Mudumalai is also noted for its abundance of gaur or Indian ' bison '. This impressive beast is the largest and undoubtedly one of the most stately of the world's wild bovines or oxen (Plate II). It generally is associated with the sanctuary's moist deciduous forests and the ease with which a herd can melt silently into the forest is amazing. Herds of over 50 gaur are not uncommon and herds numbering more than 80 have been reported. Wild elephants (Plate III) are generally encountered by visitors to the sanctuary. Herds of 30 or more are observed not infrequently, but smaller groups or solitary males are the general rule.

Diurnal mammals, such as the common langur, the bonnet macaque and the brightly coloured giant or Malabar squirrel, are common and seen by almost all visitors.

Other mammals which are relatively common in various parts of the sanctuary may or may not be observed. These include such animals as sambar, barking deer or muntjac, mouse deer or Indian chevrotain, wild boar, blacknaped hare and Indian porcupine. Although rarely seen during the day, the last two are commonly observed at night. The Nilgiri langur is not found in the sanctuary. However, while travelling between Mudumalai and Ootacamund in September 1965, I observed a troop in the forests above Gudalur, less than 15 miles west of Abhayaranyam. Although not uncommon in Mudumalai, visitors may be considered lucky if they observe large carnivores, such as tiger, leopard or panther, dhole or Indian wild dog and sloth bear. The latter is actually an omnivore and feeds primarily on insects, fruits, and so forth. However, some visitors have reported three of these four species during a one or two-day visit and others have observed all four during a more extended visit.

A species of ' flying ' lizard (*Draco* sp.) is reported to be fairly common in some parts of the sanctuary, such as in the vicinity of Abhayaranyam. I searched for this reptile on several occasions, but was never lucky enough to observe it. Although called a ' flying ' lizard, it is incapable of flight. It glides from tree to tree in the same manner as the ' flying ' squirrels, which also are represented in Mudumalai.

Python, the largest of India's snakes, and monitor lizards (*Varanus* sp.) are seen occasionally in Mudumalai, but crocodile is observed very rarely along the Moyar River. The Indian rat snake, however, is common and frequently encountered along the sanctuary's roads. I observed one specimen, which was approximately eight feet long, just east of the Abhayaranyam Forest Rest House. ' Some Large Reptiles of Madras State ' are described and illustrated in a Forest Department booklet of that name by M. A. Badshah, the State Wild Life Officer. Some of the

animals inhabiting the Mudumalai sanctuary, including some of the more common or impressive reptiles, are listed in Table 2.

Mudumalai is a paradise for the bird watcher. A detailed check-list of birds has been compiled by M. A. Badshah, and the check-list made available to visitors. A latest check-list is under print with photographs of some rare birds. February through June is the breeding season for most of the birds in Mudumalai and the best time for bird watching or hearing their songs, as well as for observing other wild animals in the sanctuary. A check-list for these also should be made available to visitors and their observations systematically recorded in the visitors' book.

TABLE 2

NAMES OF SOME OF THE ANIMALS INHABITING THE MUDUMALAI WILD LIFE SANCTUARY IN MADRAS STATE

| English | Tamil | Scientific | Relative Abundance |
|---|---|---|---|
| Indian Elephant | Yanai | *Elephas maximus* | common |
| Gaur or Indian 'Bison' | Kattu erumai | *Bos gaurus* | common |
| Sambar | Kudoo marn | *Cervus unicolor* | frequent |
| Chital or spotted Deer | Pulli marn | *Axis axis* | common |
| Barking Deer or Indian Muntjac | Kart ardu | *Muntiacus muntjak* | infrequent |
| Four-horned Antelope or Chousingha | Nangu kombu marn | *Tetracerus quadricornis* | infrequent |
| Mouse Deer or Indian Chevrotain | Sarugoo marn | *Tragulus meminna* | frequent |
| Wild Boar | Punri | *Sus scrofa* | frequent |
| Blacknaped or Common Hare | Muyal | *Lepus nigricollis* | frequent |
| Indian Porcupine | Mullampunri | *Hystrix indica* | common |
| Giant or Malabar Squirrel | Anil | *Ratufa indica* | common |
| Small Travancore Flying Squirrel | Parakum anil | *Petinomys fuscocapillus* | frequent |
| Common or Grey Langur | Korangu | *Presbytis entellus* | common |
| Bonnet Macaque | Korangu | *Macaca radiata* | frequent |
| Indian Pangolin | Alangu | *Manis crassicaudata* | rare |
| Tiger | Puli | *Panthera tigris* | infrequent |
| Leopard or Panther | Chiruthai | *Panthera pardus* | infrequent |
| Jungle Cat | Kattu poonai | *Felis chaus* | —— |
| Leopard Cat | —— | *Felis bengalensis* | infrequent |
| Striped Hyena | Kaluthai puli | *Hyaena hyaena* | rare |
| Indian Wild Dog or Dhole | Chennai | *Cuon alpinus* | infrequent |
| Otter | Neer nai | *Lutra* sp. | rare |
| Jackal | Naree | *Canis aureus* | frequent |
| Indian Fox | Kulla naree | *Vulpes bengalensis* | —— |
| Little Civet | Punugu poonai | *Viverricula indica* | —— |
| Stripe-necked Mongoose | Keeree | *Herpestes viticollis* | —— |
| Sloth Bear | Karadee | *Melursus ursinus* | infrequent |
| Python | Malai Pambu | *Python molurus* | infrequent |
| Indian Rat Snake | Sarai Pambu | *Ptyas mucosus* | common |
| Monitor Lizard | Udumbu | *Varanus monitor* | rare |
| 'Flying' Lizard | —— | *Draco dussumieri* | frequent |
| Marsh Crocodile or Mugger | Mudalai | *Crocodilus palustris* | rare |

An unusual, but outstanding and oftentimes beautiful feature of Mudumalai is its abundant insect life. During some nights in April entire areas in the sanctuary are illuminated by the flashing luminescence of fire flies. Although these small creatures are present and noticeable during much of the year, only during particular seasons do they become so apparent. Not to be overlooked are the sanctuary's numerous species of intricately-coloured butterflies.

The spiders, which spin their giant webs between the trees, and the mounds of the termites also form a conspicuous part of the sanctuary. I was intrigued particularly by the colourful patterns of some of the spiders and spent the better part of one afternoon photographing these beautiful creatures. Many display intricate designs of bright yellow or reds on a black background and some attain relatively large sizes, spanning more than five inches across both the body and legs.

Good numbers of fair-sized fish inhabit the Moyar River below Kargudi. The tribal people working in the sanctuary were having exceptionally good luck one evening during my visit. Although I was not acquainted with the species which they caught, I watched them catch a number of fish weighing up to three pounds and they claimed that they were very good eating.

## Other Attractions

The exquisite flora and fauna are, of course, the outstanding attractions of the Mudumalai Wild Life Sanctuary. Nevertheless, there are a number of scenic or other attractions in or near the sanctuary, which I think deserve major consideration. The elephant camp near Teppakadu, which is on the eastern side of the river about a mile from Kargudi, is of special interest. It is claimed that more elephants have been born in captivity here than anywhere in India. About 20 elephants are stationed at the camp or at nearby camps in the sanctuary's forests. Most are used for timber work, although a few are made available for visitors to ride.

Some of the mahouts take pride in demonstrating the abilities of their charges. These highly intelligent beasts will bow, ' salaam ', pick up delicate objects with their versatile trunks and appear in many cases to be able to do almost anything their mahouts ask of them. Many respond correctly to over 30 commands. These are given vocally, by leg and foot signals, or through prodding with a small stick. The mahouts are not allowed to use ' ankus ' or force to make these huge animals do their bidding. A small calf or two usually may be found in the camp. Their inadroit movements and apparent uselessness of their trunks contrast notably with those of their parents.

East of the main Ootacamund-Mysore road near the Madras-Mysore

border in the Moyar Block is a loop road. This passes through relatively open forests. The Forest Department recently built a spur road from it to an observation point overlooking the falls and gorge of the Moyar River. The falls are estimated to be approximately 500 feet high. The deep rocky gorge and the surrounding forests, coupled with the cascading waters, present a truly magnificent spectacle.

An equally impressive sight is presented by the Segur River Falls (Plate I). The Segur River rises in the Nilgiri Hills to the south and flows along the eastern boundary of the sanctuary before tumbling an estimated 700 feet into the Moyar River Gorge. The Segur River and its two spectacular falls are located outside the sanctuary and at present may be reached by passing through the village of Hundiuyur and then following a jeepable cow path. An effort should be made to include the falls within the sanctuary. A suitable road leading to the observation point overlooking them also should be constructed. The nearby village of Hundiuyur, which has about 500 inhabitants, likewise should be relocated elsewhere so that the scenic grandeur of one of nature's finest displays may be preserved in its natural setting. This area presently is under the jurisdiction of the Revenue Department, which leases the land to the villagers for approximately Rs. 6 per acre per year. The rocky soil is unsuitable for agriculture and rightfully should be returned to forest.

The Nilgiri Hills to the south and east provide a magnificent setting for the Mudumalai Sanctuary. The steep slopes of this range, with the exception of frequent outcroppings of rock, are covered primarily with grass. They are frequently covered with mist and thin clouds trailing across their face add to their majesty. Particularly in the early morning, they are often cloaked in deep blues or purples—reminiscent of the colours used in many paintings of mountain scenery, but which are colours not commonly seen in natural settings. The winding journey up the steep slopes from Gudalur, 10 miles south-west of Kargudi, to the hill station of Ootacamund on the summit of the Nilgiris is an unforgettable experience. It may be uncomfortably warm at the beginning of the trip, but almost invariably one will be searching for a sweater or jacket while winding back and forth up the mountainsides, which are covered with tea plantations that appear like neatly trimmed hedges.

## Discussion

The timber resources of the Mudumalai Wild Life Sanctuary are under the jurisdiction of the Forest Department. The State Wild Life Officer is in charge of all the wild life sanctuaries in the State. It is realized that the forest products of Mudumalai provide a valuable source of revenue. However, the wild life in a wild life sanctuary should receive major consideration.

It is illogical at present to advocate the cessation of all forest operations within the sanctuary. But, on the other hand, whenever possible such operations should be planned and executed in the manner least detrimental or in a manner that will least disturb the sanctuary's wild life. For example, there is little justification for the establishment of a forest camp along the Kakkanahalla on one of the main migratory routes for wild life between Mudumalai and the Venu Gopal Wild Life Park in Mysore. This camp easily could have been located elsewhere where it would have interfered less with wild life movements. Extensive artificial plantings of trees, particularly exotic species such as *Eucalyptus*, should be discouraged within the sanctuary. Natural forests in this area are very productive and when properly managed probably will produce almost equal to plantation areas, if the additional expense and labour for the latter are taken into consideration. Extensive single species plantings often result in soil deterioration and a lower quality of timber, as well as form a biological desert as far as many species of wild animals are concerned.

The entire Mudumalai Sanctuary is subject to forest exploitation. The establishment of key areas solely for wild life, which are maintained inviolate to the depredations of man, has proven successful in a number of Indian wild life sanctuaries. The Bandipur Sanctuary or ' sanctum sanctorum ' of the adjoining Venu Gopal Wild Life Park is a notable example. At least a token area, perhaps 10-square-miles, also should be set apart in Mudumalai as a true refuge for wild life. And, such an area should be maintained in as natural a state as possible.

A basic essential in the development and proper management of a wild life sanctuary is a good staff. Regretfully I have found relatively few such men in the sanctuaries that I have visited in India. More often than not those administering wild life areas have not been able even to identify many of the animals under their jurisdiction, let alone give factual information concerning their natural history.

Forest Department personnel should be encouraged to learn about wild life. Those who demonstrate a genuine interest in wild life should be given further opportunities to develop these interests. Wild life management is a technical profession and proper training, as well as interest and dedication, is needed by those entering this field. Openings for personnel qualified to manage wild life resources should be made available in the Forest Department and specifically in the State Wild Life Organization. Such positions also should be given the status they deserve and personnel who prepare themselves for such occupations should be sufficiently reimbursed.

There are at least 11 villages within the Mudumalai Sanctuary : six in the Masinigudi area and five in the Mudumalai Block. The estimated inhabitants for these villages total approximately 10,000 people, of which

about 4000 live in the village of Masinigudi. Large numbers of people near or within the confines of a sanctuary are not compatible to the preservation of wild life. Although villagers may be law-abiding, their presence in large numbers almost invariably results, either directly or indirectly, to the detriment of wild life. These detrimental effects often take the form of habitat destruction through agricultural use of the land or overgrazing by domestic livestock.

There are over 500 acres of land devoted to agriculture and over 2000 head of livestock grazed for very nominal fees in the Masinigudi area of the sanctuary. Grazing fees are : adult cows, Re. 0.50/year ; adult buffalo, Re. 1.00/year and sheep, Re. 0.25/year. Goats are prohibited. Large numbers of both domestic livestock and wild ungulates, particularly chital, in this area have resulted in severe overgrazing. Measures should be undertaken to reduce the numbers of both classes of grazing animals and then to maintain their numbers in balance with the grazing capacity of the area.

The rest of the sanctuary is relatively little disturbed by agricultural practices or by domestic livestock grazing. Hopefully it will remain this way. However, approximately 500 head of cattle per week pass through the sanctuary travelling from Mysore to Kerala for slaughter. These cause a disturbance, although measures have been taken to insure that they remain on the main roads and do not enter the sanctuary's forests. The Forest Department also requires that all the animals be inoculated to help prevent the spread of disease.

Poaching is not considered by the Forest Department to be a major problem in Mudumalai. However, with nearby areas open to shooting, both to the east and to the west, and with the number of vehicles that ply the roads through the sanctuary at night, it appears that poaching may be more of a problem than is realized. This was further suggested during my visits to the Masinigudi area on the eastern end of the sanctuary. Among the chital of that area, I observed a sex ratio of from four to five adult females for every adult male, whereas in a sanctuary where the animals are protected a sex ratio closer to 1 : 1 would normally be expected. Admittedly it is a mere conjecture on my part that poaching may be a factor, but I think it does deserve further investigation.

Overall the facilities and services provided for visitors to Mudumalai are excellent. The Forest Department and particularly the State Wild Life Organization are to be commended. It is hoped that a few suggestions, however, may help to make the Mudumalai Sanctuary even more attractive for visitors. Because of the dense vegetation in many parts of Mudumalai the viewing of wild animals and their photography is difficult. Therefore, as previously suggested by Mr. E. P. Gee of the Indian Board for Wild Life, I think the creation of 'a few grassy areas or *maidans* of, say, 200 or 300 yards in width, in suitable areas accessible to

visitors, where wild life could be viewed in the open, as at Kanha in Madhya Pradesh ' should be considered.

I was informed both during my September 1965 and December 1966 visits to Mudumalai that the roads in the western part of the sanctuary were impassable. Therefore, I still have not had the opportunity of visiting much of the Benne Block or the northern part of the sanctuary. If at all possible, these roads should be maintained so that visitors are not restricted primarily to the main road or the roads in the somewhat atypical Masinigudi area. Nevertheless, as in the Venu Gopal Wild Life Park, it would be well to permit visitors on these roads only when accompanied by a member of the sanctuary staff.

Some excellent pamphlets concerning wild life are already made available to visitors by the Forest Department. It is further suggested that additional literature, namely, appropriate postcards, check-lists for mammals and birds, books on Indian birds and animals, etc., also be made available. These, as well as those presently distributed free of charge, could be sold at nominal prices in the forest rest houses or at the sanctuary headquarters in Kargudi. Standard books on mammals and birds are available in the rest houses for the use of visitors. Wild life picture postcards are under print.

A number of complaints concerning the inefficiency of the present system for making reservations in Mudumalai were noted in the visitors' book. I was also informed and personally witnessed in 1965 that visitors without reservations may be turned away from an almost empty Forest Rest House. This is because reservations are not made at the sanctuary, as they should be, but in Ootacamund. The first notice that the staff often has is when visitors arrive with their reservations. Thus, members of the staff do not dare provide accommodations for visitors without reservations for fear that those with reservations might arrive later and be upset by the inconvenience that may result. There are daily bus and mail services between Ootacamund and the sanctuary, as well as telephone service. Therefore, there is no reason why bookings for reservations cannot be made more efficiently at the sanctuary's headquarters and the D.F.O. in Ooty then notified, instead of the other way around.

Other suggestions have been made in the main text of the Mudumalai section of this report. Some of the general suggestions given for the Vedanthangal Water-Bird Sanctuary (P. 653) also apply equally well to Mudumalai.

## II. THE VEDANTHANGAL WATER-BIRD SANCTUARY

### Introduction

Nesting colonies of water-birds near villages in south India have been protected by villagers since ancient times. Thus the preservation of such colonies has become a part of the traditional culture of many of the rural

people in this part of India. The nesting colony of water-birds near the village of Vedanthangal in the north-western part of the Maduranthakam Taluk of Chingleput District in Madras State is perhaps the most spectacular of these colonies. It is perhaps also the oldest bird sanctuary in south India. Although only officially recognized and maintained by the Government as a sanctuary since 1936, Vedanthangal has been essentially a sanctuary for water-birds for more than a century and a half. Documentary evidence clearly indicates that the villagers of Vedanthangal have actively safeguarded the colony at least since 1790.

The Vedanthangal Sanctuary is a prime example of wild life conservation by the local people through their understanding of some of the true values of wild life. It further demonstrates that an enlightened public will take the measures necessary to preserve and protect the natural resources under their jurisdiction—if they but understand some of the benefits to be derived by so doing.

## Habitat

Vedanthangal is 400 feet (122 metres) above sea-level and less than 30 miles inland from the Bay of Bengal. Rainfall averages approximately 45 inches (1143 mm.) per annum, most of which falls during the north-east monsoon between September and December. The south-west monsoon is only of minor importance. The hottest months are April to June, when maximum temperatures often exceed 100° F. (37·8° C.). The coolest months are December and January, when the minimum and maximum average monthly temperatures are respectively 65° F. (18·3° C.) and 80-85° F. (26·7-29·4° C.).

The countryside surrounding Vedanthangal is flat, comprised primarily of rocky plains interspersed with scattered bushes and trees. There are frequent low-ridged hillocks and tanks or small lakes dotting the landscape. The latter are used for irrigation, although these low-lying areas are subject to extensive flooding during the heavy rains of the north-east monsoon.

The combination of agricultural lands and seasonal inundation in this region generally provides a plentiful supply of food for the water-birds of Vedanthangal. This undoubtedly is one of the primary reasons why such large numbers of birds gather here during the breeding season. Another important factor is that the approximately 74-acre Vedanthangal Tank, which comprises the sanctuary, is the only one in this region that provides a compact grove of trees suitable for nesting. This grove, which is more or less centrally located in the Vedanthangal Tank, consists of about 500 *Barringtonia acutangula* trees. This species withstands seasonal water-logging quite well. The trees form a compact grove with an almost contiguous canopy 15 to 20 feet high, which occu-

pies approximately half of the area of the tank and offers a suitable nesting site for water-birds.

The Forest Department has been attempting to augment the number of trees in the grove inside the tank. One thousand *Barringtonia* seedlings were planted in 1966. The tank is dry approximately four months each year. However, with the arrival of the monsoon some of the seedlings were soon inundated and eventually died.

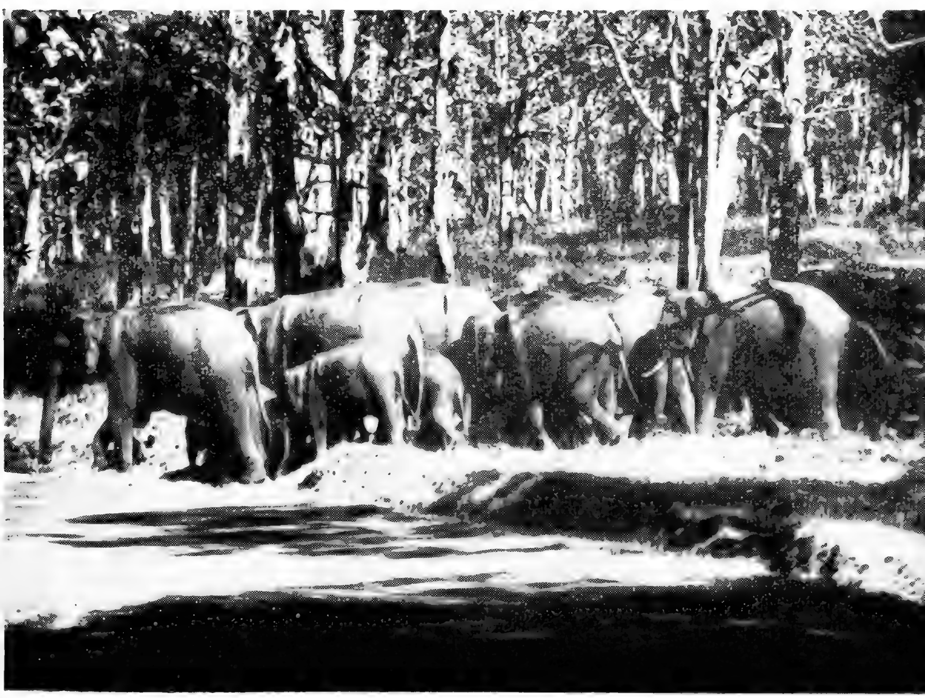
A bund or dam along the western side of the sanctuary impounds the water of the tank. A path bordered by trees and bushes runs along the top of the bund. The dominant tree species here are : Siris (*Albizzia lebbeck*), Babul (*Acacia arabica*), Alingi (*Alangium lamarcii*), and Palmyra (*Borassus flabellifer*), which are interspersed with a thick undergrowth of Cane (*Calamus rotang*). The water-birds do not inhabit the trees along the bund, but these trees both help to protect the tank and provide suitable habitat for other species of birds.

A cyclone, with winds exceeding 100 m.p.h., hit much of the eastern part of Madras State on November 3, 1966. Although the Vedanthangal bund luckily was not damaged, many of the trees along it were broken or uprooted. Much of the path was still in a mess during my visit a month later. About 70 tanks in the Maduranthakam Taluk in which Vedanthangal is located were damaged by this cyclone. As a result, many of these tanks did not contain water at the time of my visit. It was feared that the lack of water in surrounding areas would adversely affect the water-birds of Vedanthangal, as well as the 200 villages that are dependent upon these tanks for irrigation water.

The richness of the agricultural fields irrigated from the Vedanthangal Tank bear testimony to the manurial potency of the sanctuary's waters. The droppings of the birds nesting in the middle of the tank fall into the water, most of which eventually reaches the farmers' fields. The tank water contains high fertilizing properties. Even the silt, which is scraped up from the tank's bottom by the villagers during the dry season, is highly valued as a fertilizer for crops. The sanctuary's birds also help to control many agricultural pests, such as insects. Therefore, not only is the bird colony benefited by the protection afforded by the local villagers, but the villagers are benefited in return. This demonstrates that man and wild life may live together in harmony and that both may be mutually benefited.

## Birds

Depending upon the onset of the north-east monsoon rains, water-birds begin to arrive at Vedanthangal in late September or early October. The birds continue to arrive up until November, during which time they are commonly observed bringing sticks and other nesting materials to the colony from surrounding areas. The arriving birds progressively colo-



*Above:* A solitary tusker; *Below:* A herd of elephants—Mudumalai Sanctuary.
(*Photos: M. A. Badshah*)

Spillett : Wild Life Surveys

*Above :* Juvenile Openbilled Storks in nesting colony, Vedanthangal Sanctuary ; *Below :* Flamingos at Point Calimere Sanctuary.

(*Photos : M. A. Badshah*)

nize the available trees surrounded by water in the approximately 74-acre tank. The trunks of the trees nearest the bund, which is on the western side of the sanctuary, are the first to be submerged and hence colonized.

Nesting, hatching and the feeding of young continue from the onset of the breeding season until the young are fledged. The season usually is over by April. The birds then depart and the tank dries up. Although difficult to determine accurately, it has been estimated that at the height of the breeding season there are generally between five and six thousand water-birds in the sanctuary, including both adults and young.

No trees are colonized exclusively by a single species, although certain species predominate in particular areas. For example, the majority of the night herons appear to inhabit the southern corner of the colony, the openbilled storks (Plate IV) and grey pelicans predominate in the tops of many of the trees; egrets and spoonbills commonly are observed in the lower branches near the water. However, for the most part the colony presents a conglomeration or hodgepodge of whites, greys, and blacks. The peripheral trees on the sides of the grove inside the tank are used little for nesting, but serve as roosting trees.

According to M. Krishnan, night herons, little egrets, little cormorants and shags are the most numerous species of water-birds nesting at Vedanthangal. Openbilled storks, grey herons, spoonbills, cattle egrets, white ibises, medium egrets and pond herons follow, more or less in that order. Darters or snakebirds are present in lesser numbers and large egrets and large cormorants are relatively rare. Only two or three pairs of large cormorants normally nest at Vedanthangal. M. A. Badshah also claims that spottedbilled or grey pelicans have been observed to nest at Vedanthangal, and that fifty pairs of grey pelicans nested during the 1966-67 season.

Besides the water-birds that regularly nest in the trees at Vedanthangal, the dabchick or little grebe and the Indian moorhen also nest in the vegetation surrounding the tank. Nesting water-birds, visiting water-birds and scavenger or predatory birds which may be observed at Vedanthangal are listed in Table 3. In addition, numerous species, mainly perching or passerine birds, inhabit the trees along the bund and the vegetation surrounding the tank. A partial list of these includes: golden oriole, blackheaded oriole, blue jay or roller, pied crested cuckoo, goldenbacked woodpecker, Mahratta or yellowfronted pied woodpecker, weaver birds, Indian pitta, several species of wagtails, Indian courser, red-and yellow-wattled lapwings, hoopoe, Indian robin, king crow, bee-eaters, baybacked shrike, koel, purple sunbird, crow-pheasant, white-bellied drongo, crimsonbreasted barbet, several species of doves, partridges, and so forth.

TABLE 3

BIRDS INHABITING THE VEDANTHANGAL WATER-BIRD SANCTUARY IN MADURANTHAKAM TALUK OF CHINGLEPUT DISTRICT IN MADRAS STATE

| English | Tamil | Scientific | Remarks |
|---|---|---|---|
| *NESTING WATER-BIRDS:* | | | |
| Little Cormorant | Neer-Kaakkai | *Phalacrocorax niger* | abundant |
| Shag | ,, ,, | *P. fuscicollis* | abundant |
| Large Cormorant | ,, ,, | *P. carbo* | rare |
| Darter or Snakebird | Paambu-thaara | *Anhinga rufa* | frequent |
| Little Egret | Vellai-Kokku or Ven-Kokku | *Egretta garzetta* | abundant |
| Medium Egret | ,, ,, | *E. intermedia* | common |
| Large Egret | ,, ,, | *E. alba* | rare |
| Cattle Egret | Maatu-Kokku or Unni-Kokku | *Bubulcus ibis* | common |
| Pond Heron or Paddy Bird | Madayaan or Kuruttu-Kokku | *Ardeola grayii* | common |
| Night Heron | Vakka | *Nycticorax nycticorax* | abundant |
| Grey Heron | Naarayana-patchi or Narayaan | *Ardea cinerea* | common |
| Openbilled Stork | Naththai-koththi Naarai | *Anastomus oscitans* | common |
| Spoonbill | Mamptivaayan or Manvetti-vaayan | *Platalea leucorodia* | common |
| White Ibis | Arivaal-mookkan | *Threskiornis melanocephalus* | common |
| Indian Moorhen | Kaanaankozhi | *Gallinula chloropus* | frequent |
| Dabchick or Little Grebe | ——— | *Podiceps ruficollis* | ——— |
| *VISITING WATER-BIRDS:* | | | |
| Spottedbilled or Grey Pelican | | *Pelecanus philippensis* | frequent |
| Painted Stork | | *Ibis leucocephalus* | rare |
| Plovers | | *Charadrius* spp. | common |
| Spotted Sandpiper | | *Tringa glareola* | ——— |
| Common Sandpiper | | *T. hypoleucos* | ——— |
| Little Stint | | *Calidris minutus* | frequent |
| Blackwinged Stilt | | *Himantopus himantopus* | common |
| Avocet | | *Recurvirostra avosetta* | rare |
| Stone Curlew | | *Burhinus oedicnemus* | rare |
| Curlew | | *Numenius arquata* | infrequent |
| Purple Moorhen | | *Porphyrio porphyrio* | ——— |
| Whitebreasted Waterhen | | *Amaurornis phoenicurus* | ——— |
| Coot | | *Fulica atra* | common |
| Common or Green winged Teal | | *Anas crecca* | common |
| Garganey or Bluewinged Teal | | *A. querquedula* | common |
| Pintail | | *A. acuta* | frequent |
| Shoveller | | *A. clypeata* | frequent |
| Grey or Spotbill | | *A. poecilorhyncha* | frequent |
| Comb Duck or Nukta | | *Sarkidiornis melanotos* | frequent |
| *SCAVENGERS OR PREDATORS:* | | | |
| House Crow | | *Corvus splendens* | abundant |
| Common Pariah Kite | | *Milvus migrans* | common |
| Brahminy Kite | | *Haliastur indus* | common |
| White Scavenger Vulture | | *Neophron percnopterus* | common |
| Short-toed Eagle | | *Circaetus gallicus* | rare |
| Marsh Harrier | | *Circus aeruginosus* | common |
| Kestrel | | *Falco tinnunculus* | infrequent |

*Note.*—Numerous species of perching or passerine birds, many of which nest at Vedanthangal, also may be observed in the vegetation and trees surrounding the Vedanthangal Tank.

## Visitor Facilities

The Vedanthangal Water-Bird Sanctuary is located 51 miles south of the city of Madras. The nearest airport is at Meenambakkam, near Madras, and the nearest rail head is at Karunkuzhi on the Madras-Villupuram main line, five miles east of the sanctuary. It should be noted that only passenger trains, not mail trains, stop at Karunkuzhi. However, both stop at Chingleput, which is 16 miles north of Vedanthangal. Bus services are available from both locations to the sanctuary, as well as to or from Madras. There are buses between Madras and Chingleput every half hour and regular bus service from Chingleput to the sanctuary and back every hour. On every Sunday during the season a special tourist bus runs between Madras and Vedanthangal. For those travelling by private vehicle from Madras, the turn-off from the main road at the 43rd milestone (the Grand Southern Trunk or GST Road) is well-marked by a large sign telling about the sanctuary eight miles to the east. Nearby points of interest include the archaeological finds at Mahabalipuram and the famous historic temple at Tirukalikundram.

The season for observing the nesting water-birds at Vedanthangal is dependent upon the commencement, extent and duration of the north-east monsoon rains. Generally speaking, however, the season extends from September-October through March-April, the best months being November, December and January. The sanctuary is open to visitors throughout the season free of charge. The only restrictions are that visitors may not enter the tank or molest the birds. The best time to visit the sanctuary is from 4 o'clock in the afternoon onwards. Large flights of birds return to the sanctuary shortly before sunset and the visitor on the bund then has the sun behind his back, which gives him a clear view of the sanctuary's activities. There is also a peak of activity in the early morning, but the sun is then opposite the observer on the bund.

The Collector of Chingleput officially recognized Vedanthangal as a sanctuary and sanctioned the first government funds towards its maintenance in 1936. Although the Government has managed and protected the sanctuary since that time, it was not until 1960 that steps were taken to develop this area for the enjoyment of the general public. Since then a tar road leading to the sanctuary has been built and a parking lot provided below the bund. Vehicles, including large buses, are accommodated easily in the parking lot. Recently public rest rooms, an observation platform and an observation tower have been constructed along the bund on the western side of the sanctuary. Visitors may observe the activities of the sanctuary's birds from either the observation platform or tower, as well as from the tree-lined path on top of the bund.

The U.S. Consul-General in Madras used his good offices in procuring a telescope from the American Museum of Natural History, New York, through the courtesy of Mr. and Mrs. Dyer, which has been permanently mounted in the tower for the use of visitors.

A Forest Rest House also was recently constructed approximately one-half a mile from the sanctuary. The Forest Department provided both the funds and the plans for this Rs. 1,11,000 building, which was built by the Public Works Department. This rest house will provide four first class double suites and a canteen for visitors and was scheduled to be opened during the early part of 1967. The procedure for securing reservations for these suites had not been decided upon at the time of my visit. In addition, there is a Public Works Department Rest House at Karunkuzhi, seven miles from the sanctuary. No catering arrangements are provided, but reservations for this bungalow may be obtained through the District Collector at Chingleput.

A Forester and a Watchman are stationed at Vedanthangal by the Forest Department to assist visitors and to protect the sanctuary. The Vedanthangal Tank also provides water for irrigation to the nearby agricultural lands. This water passes through two sluices along the bund and two Government Watchers are charged with their supervision. It is imperative that sufficient water remains in the tank during the nesting season to protect the water-birds and their young. A recent notification issued by the Government of Madras also prohibits the shooting of water-birds within a radius of 20 miles of the sanctuary from August 1 through May 31 each year.

I was amazed by the number of visitors, particularly bus-loads of students, during my visit to Vedanthangal on Sunday, December 4, 1966. As to be expected, most visitors come to the sanctuary on week-ends. Nevertheless, the Forester stationed at Vedanthangal informed me that there were over 5000 visitors the previous day, which was Saturday, and prior to our departure that night he claimed that over 10,000 visitors were tallied that day ! This clearly demonstrates that the general public is interested in wild life—if the basic facilities are provided first so that wild life may be observed and enjoyed in relative comfort and at nominal cost. It also provides a unique opportunity to educate the public to the values of wild life and the dire need for wild life conservation in India.

It is true that many of those visiting the sanctuary do not fully appreciate what they see or are able to identify correctly more than a few of the species of birds observed. But their presence indicates a genuine interest in wild life and it behoves the Forest Department and more specifically the Wild Life Organization to provide for their education in wild life conservation. Therefore, the following general suggestions are presented : (1) An illustrated board depicting the species of

water-birds commonly observed at Vedanthangal should be erected near the bund. This would help visitors at least to identify many of the birds which they see. (2) Booklets, pamphlets, and other information concerning Vedanthangal, as well as other wild life sanctuaries in Madras and in India, should be made available at minimal cost to visitors. The booklet, THE VEDANTHANGAL SANCTUARY FOR WATER-BIRDS by M. Krishnan, which was published by the Madras State Forest Department in 1960, and THE BOOK OF INDIAN BIRDS by Sâlim Ali, published by the Bombay Natural History Society, are worthy of special note. General information concerning Vedanthangal and other sanctuaries also should be distributed through the Tourist Department. Efforts should be made to conduct regularly scheduled tours of such areas under the direction of well-qualified guides. Commercialism, however, should be avoided in wild life areas. (3) Forest Department personnel stationed in wild life sanctuaries should be very carefully chosen, as well as given instruction in the basic principles of wild life conservation. For example, the Forester and Watcher stationed at Vedanthangal should not only have a genuine interest in wild life, but should be able to identify the sanctuary's plants and animals, describe their life histories and importance, and know the history of the area. In short, they should be able to present or conduct meaningful lectures or tours of the sanctuary and to answer correctly visitor's questions. (4) Finally, accurate observations concerning the sanctuary and its wild life should be continuously recorded. Changes in population densities of different species, numbers of visitors to the sanctuary and so forth should be kept on record and made available to the public. Scientific investigations of wild life by qualified personnel also should be encouraged.

## III. THE GUINDY DEER PARK

### Introduction

Among the larger cities of India and perhaps of the world, Madras is unique in having an extensive natural park within its limits. This is the Guindy Deer Park, which includes the Children's Corner. The area comprising Guindy was the private property of Gilbert Ricketts during the early part of the 19th century. This property and his private residence (Guindy Lodge), which is the present Raj Bhavan, were purchased by the Madras Government after his death in 1817. The residence served as a week-end resort and a country residence for the Governor of Madras from 1825 until 1947. It then became the permanent residence for the Governor.

The late A. J. John, then Governor of Madras, offered to relinquish the bulk of the 1262-acre estate. While approving of this offer, the

Prime Minister of India, the late Jawaharlal Nehru, expressed the hope that the Government of Madras would preserve the park, improve it and arrange for its use as a public park with a portion marked out as a Children's Corner. The governor retained 300 acres as a part of the Raj Bhavan. Also, 407 acres were set aside for an Institute of Higher Technology, which has since been established under the supervision of the West German Government. The remaining 555 acres were set apart as a Deer Park and came under the jurisdiction of the Forest Department in March 1958.

Of the 555 acres supposedly devoted to the Deer Park, 76 acres are occupied by the Kattankollai and Applankulam tanks, 14 acres by the Children's Corner and 10 acres by a riding school built by the Riding Club of Madras. Five riding trails utilized by riding clubs occupy between 30 and 40 acres. The Park's nine miles of roads occupy approximately another 40 acres. And, 20 acres have been allotted for the establishment of a Research and Demonstration Centre for the State Silviculture Division.

Only 395 of the Park's present 555 acres in actuality are devoted to a true Deer Park as proposed in the Government Order Ms. No. 3911, Food and Agriculture, dt. 29.11.58 and approved by Government Order Ms. No. 387, Food and Agriculture, dt. 2.2.59. Additional proposals, such as for the construction of a golf course inside Guindy Park, also have been presented and are now pending.

Guindy Park has not only been desecrated and diverted from the objectives for which it was originally intended and sanctioned by the Government, but ever increasing pressures are being exerted upon the Guindy Deer Park.

**Children's Corner**

Fourteen acres in the north-eastern corner of the Guindy Deer Park, adjoining the Gandhi Memorial, have been set apart and constituted as a Children's Corner. Work was begun in January 1959 and the Children's Corner was inaugurated on April 14 of the same year by the late Jawaharlal Nehru. The Children's Corner has a two-fold objective: (1) It should serve as a recreational park and garden, and (2) it should help young people to develop an abiding interest in wild life and nature study. In the words of Jawaharlal Nehru, the aim of the Children's Corner is to help children and young folk to learn 'about this beautiful world of ours, about flowers and trees and birds and animals and ... How easy it is to make friends with them and with everything in Nature, if you go to them affectionately and with friendship'.

In keeping with the objectives for the Children's Corner, the trees and shrubs in this area have been labelled with their common and scientific names. A platform has been constructed around the base of a large

banyan tree to serve as an open air theatre for programmes, particularly for presentations during the annual Wild Life Week. A nature library for children with books on animals, birds, insects, and so forth has been established in the park. Although most of these books are in English, it is hoped that volumes in the children's native tongue will soon be made available. Four aviaries for birds and 13 enclosures for animals have been constructed. A special effort has been made to keep species of birds and animals which children may handle and with which they may become intimately acquainted. Free pony rides are given to children on Saturday and Sunday evenings and elephant rides were inaugurated in June of 1966. Ten camp sites also afford camping facilities for school children and college students. Additional recreational facilities in the Children's Corner include : a midget train that runs on Saturday and Sunday evenings, a playground with a merry-go-round, swings, bars, see-saws, sand piles and so forth.

It is sincerely hoped that in the development of the Children's Corner the primary objectives in the establishment of this park will always be borne in mind. India has perhaps a greater wealth in floral and faunal species than any other nation in the world. A special effort should be exerted to help the young people of this great nation to become acquainted with, to appreciate, and above all to understand the value of their wild life heritage. There is no need to introduce exotic plants or animals from other countries into the Children's Corner or Guindy Park. African lions and zebras, South American llamas and monkeys, and North American pumas and raccoons may be seen in almost any zoo in the world. But many of the once abundant plants and animals in India regretfully are becoming increasingly rare. Further, the endemic flora and fauna of this region would not only present a varied and spectacular display, but also something unique and worthy of note throughout the world.

An indication of the popularity of the Guindy Deer Park and the Children's Corner is presented by the number of visitors tallied by the gatekeepers during the months prior to my visit. In July 1966 there was a total of 28,330 visitors, 35,500 in August, 24,000 in September and 31,920 in October. This is a grand total of almost 1,20,000 during this four-month period. Members of the State Wild Life Organization stationed at Guindy include a Ranger, two Foresters, a Forest Guard and eight Watchers.

**Flora and Fauna**

The Guindy Deer Park represents a thorny scrub jungle, typical for much of the southern arid zone of India. Although modified to some extent, the endemic flora of the Park has been remarkably well preserved

for over a century and a half and represents one of the most natural areas to be found in this part of Madras State.

There are more than 30 naturally occurring species of trees represented in Guindy Park. Exotic tree and shrub plantings, however, have taken place inside the Park during recent years. A 47-acre plot was recently ploughed and planted with grass to provide fodder for deer. Although it has been the intention in most cases to augment the food supply of the native animals and to attract greater numbers of birds to the Park, I am of the opinion that both the flora and fauna of the Guindy Deer Park should be maintained in as natural a state as possible. Guindy is supposedly a Park, not a farm nor an orchard. Therefore, in so far as possible, it should be maintained in its natural state.

Originally the Park area was a waterless tract, but two bore wells and a number of tanks have been recently constructed. Water troughs and salt licks have been scattered throughout the Park to provide for the animals within its confines. These encourage the animals to remain inside the Park. Particularly during the dry season, animals are prone to wander outside where they are extremely vulnerable.

One of the reasons for Guindy's modification is the ever increasing demand upon the Park for uses other than those for which it was intended. For example, over 1500 people, mostly workers at the Raj Bhavan, live within the Guindy Park. Members of the Raj Bhavan staff are allowed to graze 52 head of cattle within the Park. They are likewise permitted to collect dry fuel from the Park two days each week. The Riding Club of Madras and the Madras Polo and Riders Club are permitted to use the Park for riding horseback, over 100 horses are allowed on Guindy's roads and paths and a riding school was built recently inside the Park. All of these activities modify both the floral and faunal composition of the Guindy Deer Park, as well as distract from its aesthetic values. You cannot have your cake and eat it too. It must be decided once and for all—Is Guindy going to be maintained as a TRUE Park, as was originally proposed and approved by Government orders ? Or, is Guindy gradually going to be diverted from its original objectives and eventually become just another exploited area and a park only in name ?

The Guindy Deer Park presently contains perhaps the largest herd of blackbuck existing in the Indian Union. According to the July 1966 census, it was estimated that there are over 700 head of blackbuck in the Park. This typically Indian animal is found in no other country in the world and India was once renowned for the large herds of this beautiful beast that roamed its plains from the Punjab in the north to Cape Comorin in the south. Regretfully, however, these herds have been decimated and in areas where herds of over a hundred were common less than a decade ago, it is now a rarity to see even a single animal.

In addition to blackbuck, it is estimated that there are approximately 1400 head of chital or spotted deer in the Guindy Deer Park. These beautiful animals likewise are a typically Indian species. Less conspicuous mammalian species include bonnet macaques, civet cats, common mongoose, hares and various rodents. The bird life is both numerous and varied. Peafowl and black partridge also have been introduced recently into the Park.

Large predators have been excluded from the Guindy Deer Park. Although dogs, which prey upon blackbuck and chital, occasionally breach the approximately 8-foot-high fence surrounding the Park, there are no natural checks to balance the numbers of ungulates in the Park with their available food supply. As a result, numbers of blackbuck and chital have increased until the entire Park has been severely overgrazed. The presence of domestic livestock and other disturbances also have contributed to the lowering of the area's carrying capacity. It is imperative that measures soon be taken to reduce and to maintain the Park's ungulate populations at a level compatible with the natural supply of forage. This should be undertaken by the State Wild Life Organization and done in a scientific manner. Periodically numbers of animals should be determined accurately, as well as the carrying capacity of the area, and excess animals then systematically removed.

Twelve head of white blackbuck were introduced into the Guindy Park in 1956. Only ten of these animals remain, however, I observed a number of crosses between these and the naturally occurring blackbuck in Guindy. Such animals are a curiosity and should be displayed in a zoological garden, not in a natural park such as Guindy. An effort should be made to remove these animals so that only native stock will remain inside the Park.

The Guindy Deer Park is confronted with a number of major problems, which must be overcome. Nevertheless, it is both a unique and impressive area worthy of repute. The fact that this Park is located within the confines of one of India's largest cities, readily accessible to literally millions of people, makes it even more noteworthy and imperative that it be preserved for future generations. A noted journalist and fellow countryman, Mr. Bill Ballantine, recorded in the Visitor's Book that the Guindy Deer Park is ' Without doubt one of the most pleasant animal parks of India, if not in the world'. May it so remain !

## IV. OTHER WILD LIFE SANCTUARIES IN MADRAS STATE

### The Point Calimere Wild Life Sanctuary

It has been proposed that 4272 acres (6·7 sq. miles) in the Kodiakadu Reserved Forest in the Thanjavur District be constituted as the Point Calimere Wild Life Sanctuary. The major attraction of this area is the large concentrations of flamingos and other migratory water-birds, which gather here primarily during the winter months. With the exception of the Great Rann of Kutch, nowhere in Asia may such large numbers of flamingos be seen.

Roughly half of the proposed sanctuary would consist of tidal swamps, ideal habitat for flamingos (Plate IV) and other water-birds. This part of the proposed sanctuary is located in what is known as the Great Swamp. Until 1963 the Great Swamp included over 73,000 acres of relatively virgin swamplands. However, 34,000 acres were then set apart for the extraction of salt and the manufacture of subsidiary products. In order to protect this area and preserve the thousands of birds that inhabit it, it is imperative that action be taken as soon as possible to establish and maintain the remaining part of the Great Swamp as an inviolate wild life sanctuary.

The rich and varied bird life in the proposed sanctuary includes such species as : flamingo, whistling teal, shoveller, pintail, tufted pochard, redcrested pochard, curlews, greenshank, redshank, ruff, golden and grey plovers, godwit, blackwinged stilt, whimbrel, oyster-catcher, avocet, brownheaded and blackheaded gulls, terns, and so forth.

The best season to see migrant birds at Point Calimere is between November and March. Reliable sources claim that it is not uncommon to see more than 10,000 flamingos during this season, although only about 1000 reside here throughout the year. It is further estimated that as many as 50,000 water fowl (ducks and geese) winter here, as well as 25-30,000 shore birds, such as plovers, stilts, and so forth. There are, of course, also a good number of resident bird species, which may be seen throughout the year.

The other half of the proposed sanctuary would consist of a dense dry-evergreen forest, which formerly was known as the Kodiakkarai Deer Sanctuary. This is the only forest area in the District and, although severely overgrazed by domestic livestock, the exploitation of other forest produce has been halted since 1962. Vegetation consists mainly of the following species : *Mimusops hexandra, M. littoralis, M. elangi, Memecylon edule, Salvadora persica, Maba buxifolia* and so forth.

It is estimated by the Forest Department that the proposed sanctuary presently contains over 1000 head each of blackbuck, chital or

spotted deer, and wild boar[1]. Other mammals include jackal, civet cats, mongoose, various rodents, etc. There are, however, no large predators.

Point Calimere is accessible by both train and bus. The nearest airport is at Tiruchirappalli, approximately 105 miles west of the sanctuary. There is also an airstrip that may be used by private or chartered plane at Thanjavur, 70 miles from the sanctuary. The Point Calimere railway station is near a Forest Rest House. The Great Swamp is to the west of the station and the Kodiakkarai Forest to the east. The rest house provides two double suites and reservations may be obtained from the State Wild Life Officer, c/o Chief Conservator of Forests, Central Office Buildings, 81 Mount Road, Madras-6. Point Calimere has been constituted as a Wild Life Sanctuary in Govt. Order MS No. 1821 Agriculture, dated 13-6-1967. The State Wild Life Organization has stationed a Range Officer, two Foresters and a Forest Guard here and the sanctuary has had approximately 1000 visitors per year for the past three seasons.

## Top Slip Wild Life Sanctuary

A 27,457-acre (42·9 sq. ml.) area consisting of Top Slip, Grass Hills and Attakatty in the South Division of the Coimbatore District, adjacent to the Kerala border, has been approved by the Government of Madras for a wild life sanctuary. Development of the sanctuary is pending upon the completion of the Parambikulum Aliyar hydroelectric project, which includes the blasting of rock tunnels in this area. A wild life sanctuary already has been constituted in the adjoining portion of Kerala State.

The nearest railway station is at Pollachi, about 30 miles north of the sanctuary. The nearest airport is an additional 30 miles north of Pollachi at Coimbatore. Two rest houses, one belonging to the Forest Department and the other to the Public Works Department, are located in the sanctuary. Both have two double suites and provide full facilities. Reservations may be obtained from the District Forest Officer, Coimbatore South Division, Pollachi, Coimbatore District.

The forests in this area vary from deciduous to semi-evergreen to evergreen, depending primarily upon elevation. Evergreen forests are confined primarily to the upper reaches of the Punachi Range, although there are a few compact isolated patches in the Palakadavu, Ulandi and Mount Stuart blocks of the Tunakadavu Range. Semi-evergreen forests adjoin the evergreen portions and deciduous forests predominate on the lower

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[1] See also 'The Point Calimere Sanctuary, Madras State—May 1967'. J. *Bombay nat. Hist. Soc.* **64** : 512-523 (1968)—Eds.

slopes. Mammals inhabiting the sanctuary include elephant, gaur, sambar, chital, barking deer, mouse deer or Indian chevrotain, leopard, dhole or Indian wild dog, wild boar, Nilgiri langur and common langur.

### The Manjampatti Valley Wild Life Sanctuary

The Government of Madras has approved a proposal for establishing a wild life sanctuary in the Manjampatti, Kukkal and Kudiraiyar areas of the Udumalpet Range in the south-west corner of the Coimbatore District. This sanctuary will include approximately 16,836 acres (26·3 sq. ml.) and was established primarily for the protection of the 'ash-coloured' bison or gaur, which is considered by some to be a lighter-coloured race and a special feature of this area. Other large mammals inhabiting the sanctuary are elephant, chital, sambar, four-horned antelope, wild boar, sloth bear, tiger, panther and so forth. The sanctuary is at present completely undeveloped. The area is inaccessible by modern means of transportation and no facilities are available for visitors. The Forest Department, however, proposes to construct a road into the area as soon as possible.

Dry deciduous forests predominate along the base of the hills in the Lower Punachi and Tunakadavu blocks in the Punachi Range (adjoining Sethumadai), but are confined to the upper reaches of the hills in the Udumalpet Range. Intermingled with the forests are vast stretches of grassland, encompassing numerous and compact patches of evergreen trees. 'The forest is usually found in patches in the more sheltered sites on rolling grassland, at the heads of streams, the folds of converging slopes, in wrinkles, hollows, concave declivities and depressions.'

Thorn forests predominate in the eastern portion of the Pollachi Range and over a large portion of the Udumalpet Range. These are open and low forests between 20 and 30 feet in height in which thorny species, such as *Acacia*, predominate. There is an ill-defined understorey of smaller trees and large shrubs, which are mostly spiny and with other xerophytic characters. There is little undergrowth and the soil mantle is shallow.

### The Kodaikanal Hills or Kukkal Wild Life Sanctuary

The Government of Madras is also considering a proposal for the establishment of a wild life sanctuary in the north-west corner of the Madurai District. Included in the sanctuary will be parts of the Truttar Valley in the Kodaikanal Range, the Velancombair and Kudiraiyar valleys in the Palni Range, the Kombais in Bodinayakkanur, as well as parts of the Thevaram, Ayyakudi, Kannivadi and Rettayampadi Ex-Zamindari forests.

The elevation of the proposed sanctuary varies between 2500 and 3000 feet. Forests consist primarily of a dry deciduous type, which has been somewhat retarded by frequent fires and poor soil conditions. A gallnut type of forest predominates on the upper slopes of the Palni hills in the Kodaikanal Range. Mammals inhabiting the area include elephant, gaur, sambar, chital, barking deer or muntjac, four-horned antelope, wild boar, tiger, leopard, sloth bear, jackal, Nilgiri langur, Malabar squirrel and flying squirrel.

There are no facilities for visitors to the sanctuary area at present. Private vehicles must be utilized from Kodaikanal. Problems confronting the proposed sanctuary include poaching, overgrazing by domestic livestock and exploitation of forest produce. Most of the villagers in this area have guns and restrictions on domestic livestock grazing are non-existent. Such matters should be considered carefully and steps taken at least to minimize their deleterious effects prior to the establishment of a wild life sanctuary in this area.

## The Muthukuzhivayal Wild Life Sanctuary

The establishment of a wild life sanctuary along the southern border of the Tirunelveli District in southern Madras was contemplated by Government Order MS. No. 1211, Food and Agriculture, dt. 23-3-60. At present, however, the establishment of this sanctuary has been deferred, due to disturbances caused by the construction of a hydro-electric project in this area.

An old palace (Muthukuzhi) was formerly used by the Dewan of Travancore and members of the royal family as a health resort. The palace is reached by a seven-mile bridle path from Balamore Estate. The 29-mile road leading from Balamore Estate to Nagercoil passes through the Virupuli Reserved Forest of the Azhagiapandiapuram Range for a distance of 12 miles. Here there are steep slopes and deep valleys. The region generally receives over 100 inches of rainfall between May and November and the more gentle slopes in the area are utilized for raising rubber, teak, and softwood plantations.

There are a number of swamps in the vicinity of Muthukuzhi. Vegetation up to the Balamore Estate is typically a dense moist deciduous forest with a dense and impenetrable undergrowth of cane, thorny creepers, reeds and thorny evergreen shrubs. The vegetation between Balamore and Muthukuzhivayal, which is at an elevation of 4000 feet above sea-level, consists of grasslands dotted with *shola*, reminiscent of the downs near Ootacamund. Large mammals inhabiting the area include elephant and gaur in appreciable numbers, sambar, chital, four-horned antelope, wild boar, tiger, leopard, dhole or Indian wild dog and lion-tailed macaque.

### THE MUNDANDURAI WILD LIFE SANCTUARY

The Mundandurai Wild Life Sanctuary, also called the Mundandurai Tiger Sanctuary, consists of 1,39,094 acres (217 sq. ml.) in the south-western part of the Tirunelveli District in southern Madras. The nearest railway station is 10 miles from the sanctuary at Ambasamudram. Bus service, frequent lorries or private vehicle may be taken from there to the sanctuary. The nearest airport is at Madurai, a distance of about 130 miles. A Forest Rest House with two suites and all facilities provided is located in the sanctuary and overlooks the Thambaraparani River.

The Papanasam Reservoir and hydroelectric project and a number of tribal settlements are located inside the sanctuary. The sanctuary's dry deciduous forests also are fully exploited for forest produce, such as firewood and *beedi* leaf (used for rolling cigarettes). The area is reported to be overgrazed by domestic livestock and subject to much disturbance, although the interior parts of the sanctuary supposedly are relatively little disturbed. The State Wild Life Organization has established a number of salt licks and is attempting to develop some of the sanctuary's scenic sites, as well as construct roads into the interior areas.

The dry deciduous forests in this area are intermingled with numerous thorny shrubs, as well as some bamboo in the more moist areas. Animals consist of tiger, leopard, dhole or Indian wild dog, sloth bear, sambar, chital, barking deer, mouse deer or Indian chevrotain, wild boar, Nilgiri langur and lion-tailed macaque, as well as numerous birds.

## V. ACKNOWLEDGEMENTS

I wish to thank Mr. T. Jeyadev (Chief Conservator of Forests) and the Forest Department of the State of Madras for their co-operation and assistance during my visit to Madras between November 30 and December 7, 1966. Special thanks go to Mr. M. A. Badshah (State Wild Life Officer) and Mr. C. Pavithram (Acting State Wild Life Officer during my visit) for their hospitality and assistance, as well as providing most of the information contained in this report. Range Officers K. R. Srinivasan and C. S. Hemachandran kindly accompanied and assisted me during my visit to the Mudumalai Wild Life Sanctuary. Particular thanks also goes to M. Krishnan and his wife for their hospitality during my visit to their home. Mr. Krishnan has commendably presented the cause of wild life conservation to the public. His factual and well-illustrated booklets 'The Vedanthangal Sanctuary for Water-Birds', and 'The Mudumalai Wild Life Sanctuary' were of much assistance in compiling this report.

The State Wild Life Organization for Madras is to be highly commended for its active interest in the preservation of wild life and for its notable accomplishments thus far, both in developing and helping the public to become aware of some of the State's outstanding wild life areas.

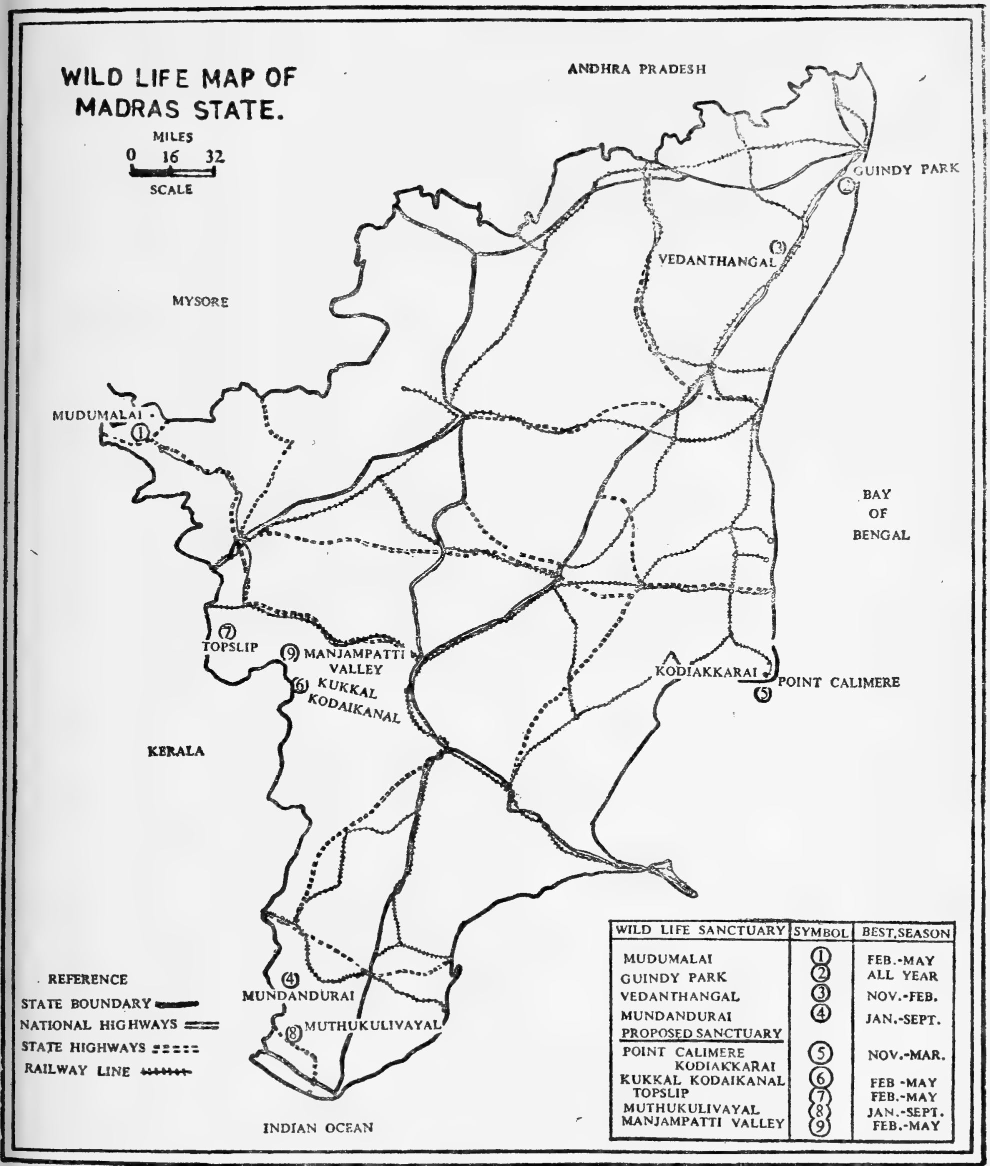


Figure 8. General map or the wild life sanctuaries in Madras State.

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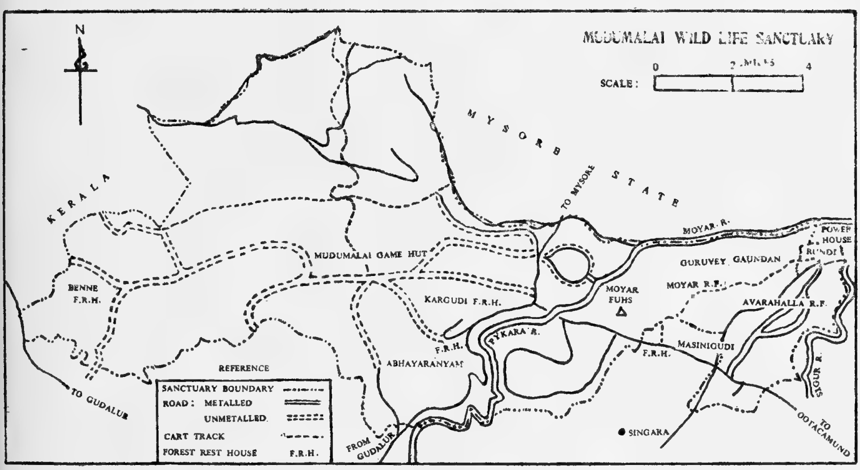


Figure 9. General map of the Mudumalai Wild Life Sanctuary in Madras State.

(*Concluded*)

# Two new species of *Iseilema* Anderss. from India

BY

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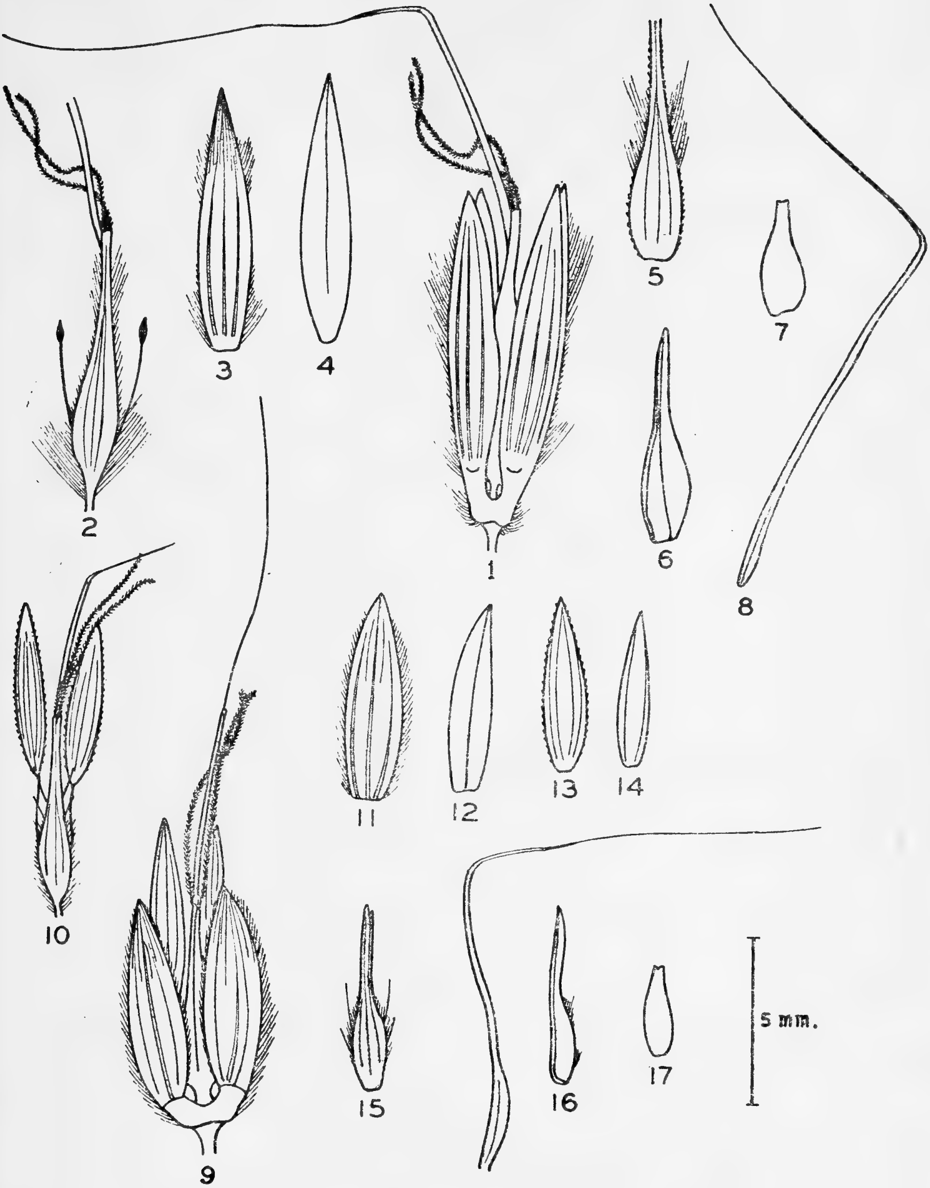
(*With a plate*)

Two new species of *Iseilema* Anderss. are described. A key to the species of *Iseilema* found in the Indian subcontinent and Burma is given, followed by an enumeration of the species.

## INTRODUCTION

The genus *Iseilema* was established by Andersson in Nov. Act. Soc. Sci. Uppsala, ser. 3, 2:250, 1856, and separated from *Anthistiria* (*Themeda* Forssk.) to which it bears a superficial resemblance in the unit of the inflorescence. The unit of the inflorescence in both these genera is characterised by the fact that the fertile spikelet or spikelets are surrounded by an involucre of four homogamous spikelets. Within the involucre are found in *Iseilema* a solitary stipitate female or hermaphrodit espikelet with two developed male or vestigial spikelets, seated on pedicels. In *Themeda* the hermaphrodite spikelets may be 1-3 in number ; when more than one, each of the lower is accompanied by a male pedicelled spikelet, while the terminal has two pedicelled male or sterile spikelets. A far more fundamental difference is the method of dispersal of the fruits. In *Themeda* the inner false raceme breaks up leaving the involucral spikelets intact and each female or hermaphrodite spikelet is furnished with a sharp callus which is covered with stiff retrorse hairs : obviously adapted to carriage by the fur of animals or the clothes of humans. Anyone who has experience of grass jungle will testify to the plague *Themeda* fruits can be—they can work their way through clothing and even puncture the skin. In *Iseilema* on the other hand, the pedicelled spikelets may fall from their pedicels but the rest of the complex falls entire, the point of abscission being below the fused pedicels of the involucral spikelets. This obviously is adapted to dispersal by wind though there is a slight possibility that the awns may become entangled in the fur of animals. The genus *Iseilema* is further distinguished by the peculiar shape of the hermaphrodite or female




Figs. 1-8. *Iseilema hubbardii* sp. nov.; 9-18. *Iseilema venkateswarlui* sp. nov.

1. A raceme showing the involucral and inner spikelets; 2. Central and the two rudimentary inner pedicelled spikelets; 3 & 4. Glumes of the involucral spikelets; 5, 6, 7 & 8. Glumes of the central spikelets; 9. A raceme showing the involucral and inner spikelets; 10. Central and the two inner pedicelled spikelets; 11 & 12. Glumes of the involucral spikelets; 13 & 14. Glumes of the inner pedicelled spikelet; 15, 16, 17 & 18. Glumes of the central spikelets.

spikelet, the tip of which is drawn out into a tail. In addition this spikelet is seated upon a stipe which is fused to the bases of the pedicels of the pedicelled spikelets.

The units of the inflorescence in *Iseilema* are seated on a short peduncle enclosed in a firmly compressed, spathe-like sheath with a reduced blade or without a blade. The whole of this structure, spathe and raceme, often breaks off at the node and this may be an additional adaptation to dispersal by wind. Sometimes the margins of the sheath are decorated by tubercle-based stiff hairs which might ensure that the structure became attached to the fur of a passing animal.

The number of species in the genus *Iseilema* is twenty-five, not including the two species described as new in this paper, of which all except two are annuals, often prostrate at the base and sending up flowering shoots from the rooting nodes. The two perennial species are *I. thorelii* A. Camus and *I. holei* Haines. The former has been collected in Siam and the latter in the State of Bihar. These two species are extremely similar in appearance and may eventually have to be merged, when the former name will have priority. It may be mentioned here, that there is only one gathering of *I. holei* at Kew, although it is said to be common in the forests of Palamau in Bihar.

Of the twenty-five species so far described, fourteen are native to Australia, six to India, two to Siam, two to the Sunda Isles and one to Cambodia. Unless *I. holei* and *I. thorelii* are the same species, not a single species of one area is found in any other (Bor, personal communication).

Two new species for India have recently been found and their descriptions are as follows.

### **Iseilema hubbardii** Murty, sp. nov.

*I. anthephoroidi* Hack. affinis sed ab ea spiculis involucralibus pedicellisque longioribus, spiculis pedicellatis ad squamas vestigiales redactis satis distincta.

Gramen annuum. Culmi primo basi prostrati nodis radicantes, demum erecti, 25-40 cm. alti, leves glabrique, teretes, pallidi vel purpurascentes, foliosi. Foliorum laminae planae, lineari-acutae, usque 15 cm. longae, 3-4 mm. latae, plurinerves, glabrae, sed marginibus basin versus pilis e tuberculis ortis sparse instructae ; culmorum vaginae plus minusve compressae, striatae, leves glabraeque, superiores cymbiformes, dilatatae, laminis brevibus instructae ; ligulae membranaceae, denticulatae. Spiculae involucrales ♂, 7-9 mm. longae, 1·5 mm. latae, lanceolato-oblongae parum acuminatae ; pedicelli 1·25-1·5 mm. longi, infra spiculas 1 mm. lati, marginibus ciliati ; stamina 3 ; antherae 3-3·5 mm. longae ; gluma inferior spiculae aequilonga, 7 nervis, dorso

plana, vel inter nervos depressa, marginibus inflexis ciliata ; gluma superior navicularis, 3-nervis, hyalina ; lemmata paleaeque plerumque desunt, si adsunt hyalinae. Spicula centralis stipitata ; stipa 1 mm. longa, apice pilis usque 3 mm. longis instructa ; gluma inferior elliptico-caudata ; pars elliptica 3 mm. longa, leviter carinata, marginibus carinaque ciliatis ; pars superior angusta 4 mm. longa, conspicue viridi-nervata ; gluma superior similis sed brevior ; anthoecia ad basin hyalinam 4 mm. longam aristae redacta ; palea hyalina 4 mm. longa ; arista *c.* 18 mm. longa ; columna torta castanea, 7-9 mm. longa. Spiculae pedicellatae ; pedicelli graciles, flexuosi ; spiculae ad squamas minutas redactae.

**Iseilema hubbardii** Murty, sp. nov.

Allied to *I. anthephoroides* Hack., but differs in the length of the involucral spikelets and their pedicels and in the extreme reduction of the inner pedicelled spikelets to rudimentary scales.

Prostrate annual herb, rooting at the nodes, 25-40 cm. tall. Stem round, and purple or white. Involucral spikelets 7-9 mm. long × 1·5 mm. wide, lanceolate-oblong, somewhat acuminate ; pedicels 1·25-1·5 mm. wide below the spikelet, ciliate on the margins. Stamens 3, anthers 3 mm. long. Central spikelet stipitate, 7-8 mm. long of which 3·5 mm. form the beak ; stipe 1 mm. long, pilose at the tip ; lower glume elliptic-oblong in the lower half, ridged on the dorsal surface, rounded on the margins, appressed hairy towards the base of the beak, pilose on the margin, 7-nerved ; upper glume similar in shape, 3-nerved ; both narrowed into the beak ; lower floret absent ; upper floret female ; lemma 4 mm. long, very narrow, produced into a perfect awn, palea a hyaline scale, 4 mm. long. Grain elliptic in outline, dorsally compressed, embryo $\frac{3}{4}$ the length of the grain. Awn 18 mm. long, column twisted, chestnut, 9 mm. long, bristle straight, scabrid. Pedicelled spikelets consist of reduced scales seated on very slender pedicels. (Figs. 1-8).

Holotype collected in the University campus of Ujjain, Madhya Pradesh, India by Murty on 22 November, 1966 under the field number IAU 3 and deposited in the Royal Botanic Gardens, Kew, England. Two isotypes bearing the same number are also deposited at Kew.

The specific epithet is given in honour of Dr. C.E. Hubbard, ex-Deputy Director, Royal Botanic Gardens, Kew, for his unique contribution to the systematics of the Gramineae as also in this particular genus.

**Iseilema venkateswarlui** Satyavathi, sp. nov.

Cum *I. anthephoroide I. hubbardiique* comparanda sed a primo spicula stipitata glumis involucralibus breviore, ab altero spiculis pedicellatis evolutis instructa, distinguitur.

Gramen annuum. Culmi basi decumbentes, nodis radicantes, demum erecti, usque 40 cm. alti, teretes, virides vel purpurascentes, leves glabrique. Foliorum laminae lineares, acutae, usque 12 cm. longae, 2-3 mm. latae, planae, marginibus scaberrimae, basin versus pilis e tuberculis ortis sparse instructae, utrinque glabrae ; vaginae striatae, plus minusve carinatae ; ligulae membranaceae, brevissimae, fimbriatae. Spiculae involucrales ♂, 5·5-7·5 mm. longae, 1·25-1·5 mm. latae, basi umbonatae, marginibus inflexis longe ciliatis ; pedicelli 1-1·25 mm. longi, 1·25 mm. lati, marginibus ciliati ; gluma inferior oblongo-acuta, viridi nervata dorso plana, apice viridinervata ; gluma superior brevior, 3-nervis, hyalina ; lemmata paleaeque ut videtur desunt ; stamina 3 ; antherae 3 mm. longae. Spicula centralis stipitata, foeminea, elliptico-caudata, stipa brevissima inclusa vix 5 mm. longa ; pars elliptica 3 mm. longa ; gluma inferior spiculae ambitu similis, membranacea, marginibus inflexis, marginibus ciliata ; gluma superior brevior, 3-nervis. Anthoecia singula ; lemma 2-3 mm. longum, angustum, ad basin aristae redactum ; palea hyalina, parva : arista 18 mm. longa ; columna torta, 9 mm. longa, castanea. Spiculae pedicellatae ; pedicelli ciliati, 4-4·5 mm. longi ; spiculae 5·5 mm. longae, masculinae, glumae anguste elliptico-lanceolatae, pleurumque vacuae.

**Iseilema venkateswarlui** Satyavathi, sp. nov.

Related to *I. anthephoroides* and *I. hubbardii*, but differs in the relative lengths of the involucral spikelets and the central hermaphrodite spikelet.

Prostrate annual herb, rooting at the nodes, 30-40 cm. tall. Stem round and purple or white. Involucral spikelets 6·5-7·5 mm. long × 1·25-1·5 mm. wide, oblong-acute, markedly umbonate at the base ; pedicels 1·25 mm. long, 1-1·25 mm. wide at the apex, densely ciliate on the outer margins ; stamens 3, 3 mm. long. Central spikelet almost sessile, 5·5 mm. long of which 3·5 mm. are elliptic and the remainder beak ; in some racemes beak longer than lower elliptic portion ; lower and upper glumes similar in nervation and indumentum to those of *I. hubbardii* ; lower floret empty ; upper floret female ; lemma and palea similar to those in *I. hubbardii*. Pedicelled spikelets present, glumes 5·5 mm. long ; anthers present, pedicels 4-4·5 mm. long (Figs. 9-18).

Holotype collected at Lam Farm, Guntur, Andhra Pradesh, India, by Satyavathi on 26 September, 1966, and deposited at the Royal Botanic Gardens, Kew, under the field number IAG 4. Two isotypes bearing the same number are also deposited at Kew.

The species is named after Professor J. Venkateswarlu under whose supervision this work was carried out.

### Key to the Indian and Burmese species

A stout perennial with culms up to 120 cm. tall; leaf-blades up to 45 cm. long ; ultimate spatheoles markedly glandular on the keels .. .. .. .. .. *I. holei*

Annuals with much shorter culms and leaf-blades ; ultimate spatheoles glandular or not :

Leaf-blades obtuse-apiculate at the tips, spinulose-scabrid on the margins towards the tips .. .. *I. argutum*

Leaf-blades linear-acute or linear-acuminate not spinulose-scabrid on the margins towards the tips :

Pedicelled spikelets absent altogether or much reduced .. .. .. .. *I. hubbardii*

Pedicelled spikelets present :

Stipitate spikelets shorter than and hidden by the involucral spikelets .. .. *I. venkateswarlui*

Stipitate spikelets projecting beyond the tips of the involucral spikelets :

Glandular tubercles present on the keels of the spatheoles and often on the nerves of the lower glumes of the involucral spikelets .. *I. prostratum*

Glandular tubercles not present on the keels of the spatheoles or only very rarely and then pedicels of the involucral spikelets as broad as long :

Pedicels of the involucral spikelets slender, longer than broad .. .. *I. laxum*

Pedicels of the involucral spikelets almost as broad as long .. .. *I. anthephoroides*

### Enumeration of the Indian and Burmese species

1. **Iseilema holei** in Haines Bot. Bihar and Orissa 1055, 1924. *Distribution :* Bihar.

2. **Iseilema argutum** Anderss. in Nov. Act. Soc. Sci. Upsal. Ser. 3, 2 : 252, 1856. *Anthistiria arguta* Nees ex Steud. Syn. Pl. Glum. 1 : 401, 1855. *Distribution* : Burma.

3. **Iseilema hubbardii** Murty. *Distribution:* Ujjain, Madhya Pradesh.

4. **Iseilema venkateswarlui** Satyavathi. *Distribution :* Andhra Pradesh.

5. **Iseilema prostratum** (*Linn.*) Anderss. in Nov. Act. Soc. Sci. Upsal. Ser. 3, 2 : 251, 1856. *Andropogon prostratus* Linn. Mant. 2 : 304, 1771. *Cymbopogon glandulosus* Spreng. Pug. 2 : 14, 1815. *Anthistiria prostrata* (Linn.) Willd. Sp. Pl. 4 : 901, 1806. *A. wightii* Nees ex Steud. Syn. Pl. Glum. 1 : 400, 1855. *Iseilema wightii* Anderss. in Nov. Act,

Soc. Sci. Upsal. Ser. 3, 2:251, 1856. *Distribution:* Throughout India, Burma.

6. **Iseilema laxum** Hack. in DC. Monogr. Phan. 6 : 682, 1889. *Distribution :* South India and Ceylon.

7. **Iseilema anthephoroides** Hack. in DC. Monogr. Phan. 6: 683, 1889. *Distribution :* South India, Maharashtra.

## Acknowledgements

We express our sincere thanks to Professor J. Venkateswarlu for guidance and for providing facilities. We are deeply indebted to Dr. N. L. Bor of Royal Botanic Gardens, Kew, for his generous help in the preparation and revision of the manuscript, for the Latin diagnosis and for his keen interest and constant encouragement. Our thanks are also due to the Director, Royal Botanic Gardens, Kew for identifications and to the Council of Scientific and Industrial Research, New Delhi for financial assistance.

# Some Wild-shot duck hybrids from the Indian Subcontinent

BY

JAMES HARRISON AND JEFFERY HARRISON

(*With four plates*)

At the request of Mr. Humayun Abdulali, who is working on the collection of bird skins belonging to the Bombay Natural History Society, we have been asked to report on five duck hybrids.

Three of these had been identified respectively as Falcated Duck × Wigeon ; Mallard × Shoveller and Mallard × Pintail. We are in full agreement with these identifications. The two other hybrids had been identified originally by the late Mr. E. C. Stuart-Baker as Falcated Duck × Shoveller, but there is a note to the effect that he had been unable to account for the plumage features of the wings. In our opinion these two specimens are in fact hybrids between the Baikal Teal and the Shoveller.

Hybrids involving the Baikal Teal have only been recorded once. This was with an American Green-winged Teal *Anas crecca carolinensis* in captivity conditions (Sibley 1938). These two specimens are therefore of exceptional interest. One further hybrid, now in the British Museum (Natural History) collection had been recorded as a hybrid between the European Green-winged Teal, *Anas crecca crecca*, and the Baikal Teal (*J. Bombay nat. Hist. Soc.* **40** : 334), but after examining this specimen, we consider it to be a Teal × Pintail, *Anas acuta.*

Our findings on all these specimens are as follows :—

**Shoveller** *Anas clypeata* × **Baikal Teal** *Anas formosa.* (Plates I, II and III)

No. 15479, Bombay Natural History Society.
27th January, 1900 ; Calcutta Market. ♂ by plumage.
No. 15474, Bombay Natural History Society.
18th March, 1915. Manipur, Assam. ♂ by plumage.

Both these specimens present features of considerable interest. On plumage characters they are presumptive males, although neither had been anatomically sexed. Both are broadly of the same type.

The character which immediately strikes one and about which there can be no doubt is that on one side the parentage must be Shoveller, in view of the pronounced Shoveller-like bill, and it is certainly safe to assume the Northern Shoveller, *Anas clypeata*,

Shoveller (*Anas clypeata*) × Baikal Teal (*Anas formosa*).
(*Photo : Pamela Harrison*)

Harrison : Hybrid Ducks

Shoveller (*Anas clypeata*) × Baikal Teal (*Anas formosa*).
(*Photo : Pamela Harrison*)

The parentage on the other side of the cross is not so evident and raises speculative issues, but we believe it was a Baikal Teal and not a Falcated Duck, as was thought by E. C. Stuart-Baker.

Description.

*Head and neck :* Both specimens present a curious facial pattern, which is quite foreign to the normal morphology of the Shoveller. In place of the glossy-green head of the drake Shoveller, both birds have acquired whitish-cream side panels, extending from the lores, cheeks, sides of face and gular areas, down the front of the neck, which is divided from the breast by a glossy-green collar. There is a tendency for the white to extend upwards as a crescent in front of the eye, which is most marked in No. 15474.

This area deserves close scrutiny. In the adult drake Baikal Teal, the same cream-coloured side panel is present, extending from the lores to the root of the neck. The gular region, however, is black and this extends halfway down the neck. The cheeks are divided by an oblique black line running from the eye slightly backwards to the black of the throat. The cream panel is thus divided into an anterior and posterior part producing a striking ' bridled ' effect.

If we examine these two hybrids closely, minimal traces of these characters can be seen, showing as small black flecking on the chin and in the gular region and, more significantly, as traces of the ' bridled ' pattern.

The crowns are bronze-coloured and the nape and back of the neck a metallic-green, which extends round the front of the lower neck as a narrow ring, as already mentioned.

*Under-parts :* There is a basic departure from both parent species in the characters of the breast, which is a rich chestnut, heavily barred with dark sepia. In No. 15479 this pattern extends onto the upper flanks. This type of plumage is rather similar to that of the drake Australian Shoveller *A. rhynchotis rhynchotis.* The flanks are pale chestnut, finely vermiculated with dark grey, and are therefore intermediate between the parent species. The lower breast and belly are creamy-white and the lower belly vermiculated with pale grey barring. The undertail coverts are black with a trace of white at the base of the tail.

*Upper-parts :* The mantle is brownish with coarse transverse sepia vermiculations. The rump is dark sepia and the uppertail coverts black with metallic green reflections. The tail feathers are pale brown with whitish margins, the central pair being darker.

*Wing :* The wing coverts are modified between the two parent species. The lesser and medium coverts are greyish-blue, while the greater coverts are broadly edged with bright chestnut, a characteristic of the drake

Baikal Teal. The speculum is green. The tertials show bluish-grey outer webs derived from the Shoveller, but the scapulars, particularly in No. 15474 show pale brownish margins, clearly derived from the Baikal Teal. The primaries are sepia.

The beak was obviously black in life and the legs, feet and webs orange, as in the Shoveller.

*Measurements in mm.* :

| | *No.* 15479 | *No.* 15474 |
|---|---|---|
| Wing (chord) .. .. .. | 254 | 252 |
| Bill-length .. .. .. .. | 52·5 | 55 |
| ,, greatest width .. .. .. | 20 | 22 |
| Tarsus .. .. .. .. | 37·5 | 37 |
| Tail .. .. .. .. | 81 | 78 |

*Discussion :* We have described elsewhere certain hybrids involving the Shoveller, Wigeon, Pintail and European Green-winged Teal, in which striking facial patterns have been produced. In their basic characters these are closely similar to the present two hybrids, although they are clearly quite different in many other respects. (Harrison : 1963, 1964, 1966.)

We believe these to be expressions of reversionary evolutionary trends, providing evidence of phylogenetic relationships. In these cases we have postulated that the Baikal Teal could well be one of the most ancestral of the duck species and it is of much interest to note in a hybrid involving this species, the same basic facial pattern is dominant.

The overlap areas in the breeding ranges of the two parent species lie in extreme eastern Siberia surrounding the Sea of Okhotsk. The Shoveller is a common winter visitor to the Indian subcontinent, whereas the Baikal Teal is rare.

**Falcated Duck** *Anas falcata* × **Wigeon** *Anas penelope* (Plate IV)

No. 22244, Bombay Natural History Society.

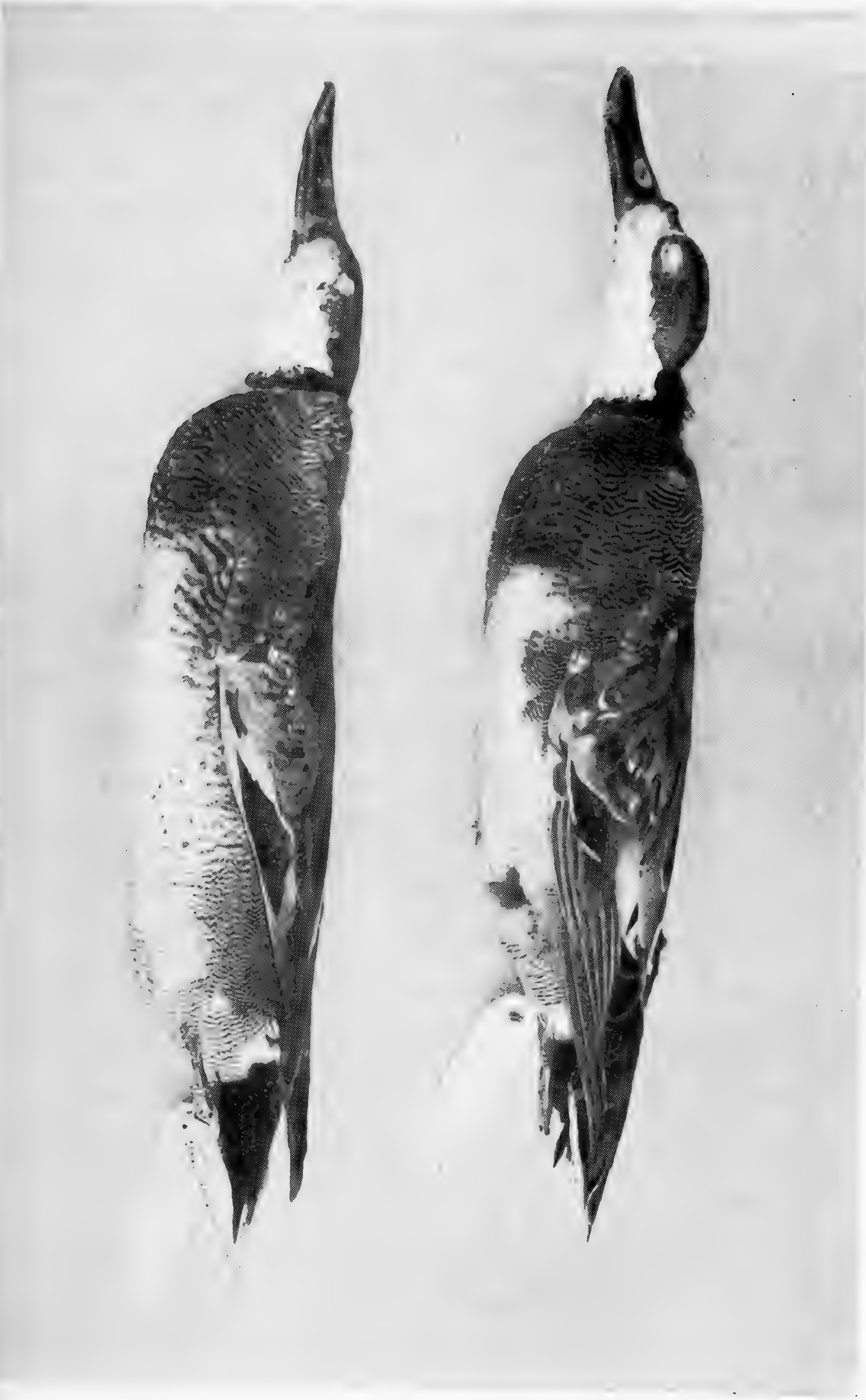
No date. Imphal, Manipur. Shot by Captain W. R. P. Williams ♂ ad. by plumage.

This bird was identified on the original label as a hybrid involving these two species by Sálim Ali, an identification with which we are in full agreement.

The specimen is an excellent example of a true intermediate between the two parent species. In general, the head and neck pattern is largely derived from the Falcated Duck, whereas the remainder of the bird is largely Wigeon.

Description.

*Head and neck :* The chin and throat are white ; the crown and cheeks are rich chestnut, merging to a bright metallic green behind the eyes,



Shoveller (*Anas clypeata*) × Baikal Teal (*Anas formosa*).
(*Photo : Pamela Harrison*)

Harrison: Hybrid Ducks

Falcated Duck (*Anas falcata*) × Wigeon (*Anas penelope*).

(*Photo: Pamela Harrison*)

which joins behind the crown and extends to the upper neck. The feathers of the nape are full, but there is no such 'crest' as in the Falcated Duck. The whole of the lower neck is a dull blackish-green. The white spot on the forehead, immediately adjoining the upper mandible of the Falcated Duck, is represented by a pale chestnut one in the hybrid.

*Under-parts :* The breast is vineous, the lower breast and belly white and the flanks finely vermiculated in white and grey, the under-tail coverts black, bordered with white anteriorly, all of which is virtually identical to a drake Wigeon.

*Upper-parts :* The whole of the upper-parts are vermiculated with grey and white with a pale brown wash, the vermiculations being coarsest at the base of the neck and becoming progressively finer towards the central upper-tail coverts. The lateral coverts are black. The tail, which is pointed, is pale sepia, the four central feathers being rather darker. Only one feature is obviously derived from the Falcated Duck and that is the small black lateral margins to some of the scapulars.

*Wing :* This is also intermediate in character between the parent species. The wing coverts are predominantly white, merging to grey, the white being rather less extensive than in a drake Wigeon. The speculum is black with metallic green reflections. The primaries are sepia, paler on the inner webs. The narrow tertials are much more elongated than those of a Wigeon, reaching to within an inch of the tips of the primaries, and are slightly down-curved, but not so sickle-shaped as in the drake Falcated Duck. The outer webs are black, bordered strongly with white and the inner webs sepia.

The beak is also intermediate in size and shape between the parent species.

*Measurements in mm :*

| | | |
|---|---|---|
| Wing (chord) | .. | 268 |
| Bill-length | .. | 41·5 |
| „ greatest width | .. | 16 |
| Tarsus | .. | 38 |
| Tail | .. | 78 |

*Discussion :*

This is the first record of a wild-bred hybrid between these two species, which we have been able to trace.

Like the two Shoveller × Baikal Teal hybrids, the overlap areas in the breeding ranges of these two parent species would appear to lie in extreme eastern Siberia surrounding the Sea of Okhotsk. Whereas the Wigeon is a common winter visitor to the whole Indian subcontinent, the Falcated Duck is a most unusual straggler. It is probable there-

fore that this hybrid had covered somewhere in the region of 4,000 miles to reach Manipur.

**Mallard** *Anas platyrhynchos* × **Shoveller** *Anas clypeata*

No. 15473 : 31—xii—1912. Bombay Natural History Society.
December 1911, Srinagar, Kashmir.

This bird was shot during a cold spell and was originally in the collection of M. J. Kennard. Unfortunately it is now rapidly disintegrating.

This specimen was not sexed, but is a male in full plumage. It is an intermediate type of hybrid, with Shoveller features tending to predominate.

Description.

*Head and neck :* The beak is predominantly Shoveller in shape, but slightly broader at the base and less broad at the tip. The lamellae at the sides of the upper mandible are present, but are less well developed than in the Shoveller. Looking at the specimen, it is obvious that the majority of the beak was black in life, but there is a paler band around the tip, which was probably greenish-yellow in life. The nail was dark.

The head and neck are a uniform blackish colour, with bright metallic blue-green reflections. These are now separated from the body, but it seems certain from the remaining feathers in this region that there was a narrow white neck ring, as in a drake Mallard.

*Under-parts :* There is a chestnut breast shield as in a drake Mallard, and this is extended downwards centrally to the mid-point of the belly. The rest of the under-parts are pale grey, finely vermiculated with sepia, while there is a chestnut suffusion over the front half of the flanks. The chestnut colour on the belly and flanks is clearly derived from Shoveller. The upper and undertail coverts are black and in front of the undertail coverts on the side there is a whitish patch. The tail itself is unfortunately missing.

*Upper-parts :* The whole of the upper-parts are sepia, becoming progressively darker over the rump, which merges with the black uppertail coverts. The feathers between the shoulders have narrow buff edges.

*Wing :* The whole of the shoulder is a dull bluish-grey, the tips of the greater wing-coverts forming a broad white bar along the inner margin of the speculum. This is predominantly green, with only a trace of blue reflection at certain angles. There is a narrow white outer margin. The tertials are sepia, the outer vanes being dark on the upper half, merging to bluish-grey along the lower half and tips. The long scapulars are a uniform dark sepia, with a narrow bluish-white central line along the lower half of the shafts.

The wing pattern therefore is predominantly Shoveller, only made rather duller through Mallard influence. The legs and feet were obviously orange in life.

*Measurements in mm. :*

| | | |
|---|---|---|
| Wing | .. | 276 |
| Bill-length | .. | 63 |
| ,, greatest width | .. | 31 |
| Tarsus | .. | 44 |
| Tail | .. | Missing |

*Discussion :*

The breeding range of these two species overlap very widely, extending to the north of the whole Indian subcontinent and it is likely therefore that the hybridisation took place in this region.

**Mallard** *Anas platyrhynchos* × **Pintail** *Anas acuta.*

No. 15384 Bombay Natural History Society.
24th May, 1915, Kashmir. Collected by M. J. Kennard. ♂ by plumage.

This specimen is a typical intermediate hybrid between these two species and is a first year bird in transitional plumage, now rather ' foxed '.

Description.

*Head and neck :* These are in moult and are generally flecked with dark brown feathers, some of which show green reflections on the back of the neck. The crown is dark brown, streaked with sepia, as in the Pintail. A white neck-ring is developing.

*Under-parts :* The breast-shield is very pale chestnut, merging to white on the lower breast, which in turn merges to grey on the rest of the belly. The flanks are finely vermiculated grey and white, with a few typical juvenile feathers still present. The undertail-coverts are black, sharply bordered with white in front and at the sides.

*Upper-parts :* These are generally sepia, finely vermiculated with grey and white between the shoulders and extending down over the scapulars. Many of the dark sepia mantle and rump feathers have the narrow pale transverse bars, typical of juvenile Pintail feathers, as have some of the tertials. The first year tertials are pale sepia with dark centers and are finely vermiculated with grey and white on the outer veins, showing Pintail influence.

Some of the upper tail coverts are black with green reflections, but most are dark sepia with the pale brown edges of retained juvenile feathers. Most of the tail feathers are also juvenile, pale brown with whitish edges, the central ones being elongated and pointed, indicative of Pintail influence. The first year feathers are greyish-brown with broad whitish edges.

*Wing :* The wing coverts are greyish-brown with the very narrow pale edges of a first year bird. The greater coverts are tipped with bright chestnut to form the anterior margin of the speculum, as in the Pintail. The speculum is metallic green, broadly edged posteriorly with a band of black and then white. The primary coverts are greyish-sepia and the primaries, darker sepia with paler inner vanes. The wing is thus typically intermediate between the parent species.

## Acknowledgements

We are most grateful to the Bombay Natural History Society and in particular to Mr. Humayun Abdulali for allowing us to examine these five most interesting hybrid ducks. We are also very grateful to the British Museum (Natural History) for loaning us the supposed hybrid between the Green-winged Teal and the Baikal Teal. We must also thank Dr. Pamela Harrison for the photographs illustrating this work.

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# Two new Phytoseiid Mites from Eastern India (Acarina: Phytoseiidae)

BY

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*Zoological Survey of India, Calcutta*

(*With six text-figures*)

Until recently no attention has been paid to the phytoseiid mites in India. In 1960 Chant described *Typhlodromus* (*Amblyseius*) *salebrosus*, *T.* (*A.*) *assamensis*, *Typhlodromus* (*Typhlodromus*) *fleschneri*, and *T.* (*T.*) *rickeri*. Narayanan & Kaur (1960) described *T.* (*A.*) *delhiensis* and *T.* (*A.*) *indicus*. The same year, Narayanan, Kaur & Ghai (1960) recorded or described *T.* (*A.*) *fallacis* (Garman), *T.* (*A.*) *ovalis* Evans, *T.* (*A.*) *asiaticus* Evans, *T.* (*A.*) *orientalis*, *T.* (*T.*) *bakeri* (Garman), *T.* (*T.*) *confusus*, *Phytoseius macropilis* (Banks), and *P. minutus*. Later Narayanan & Ghai (1963) also recorded and described the following species associated with malformation of mango trees : *T.* (*T.*) *roshanlali*, *T.* (*T.*) *rhenanus* (Oudemans), and *T.* (*T.*) *nesbitti* (Womersley). During the present study, small collections of acarina have been made in the province of West Bengal, India. In these collections two species were found to be new to science and are described herein, based on females only : *Typhlodromus* (*Amblyseius*) *amitae* sp. nov., and *Phytoseius* (*Dubininellus*) *indicus* sp. nov.

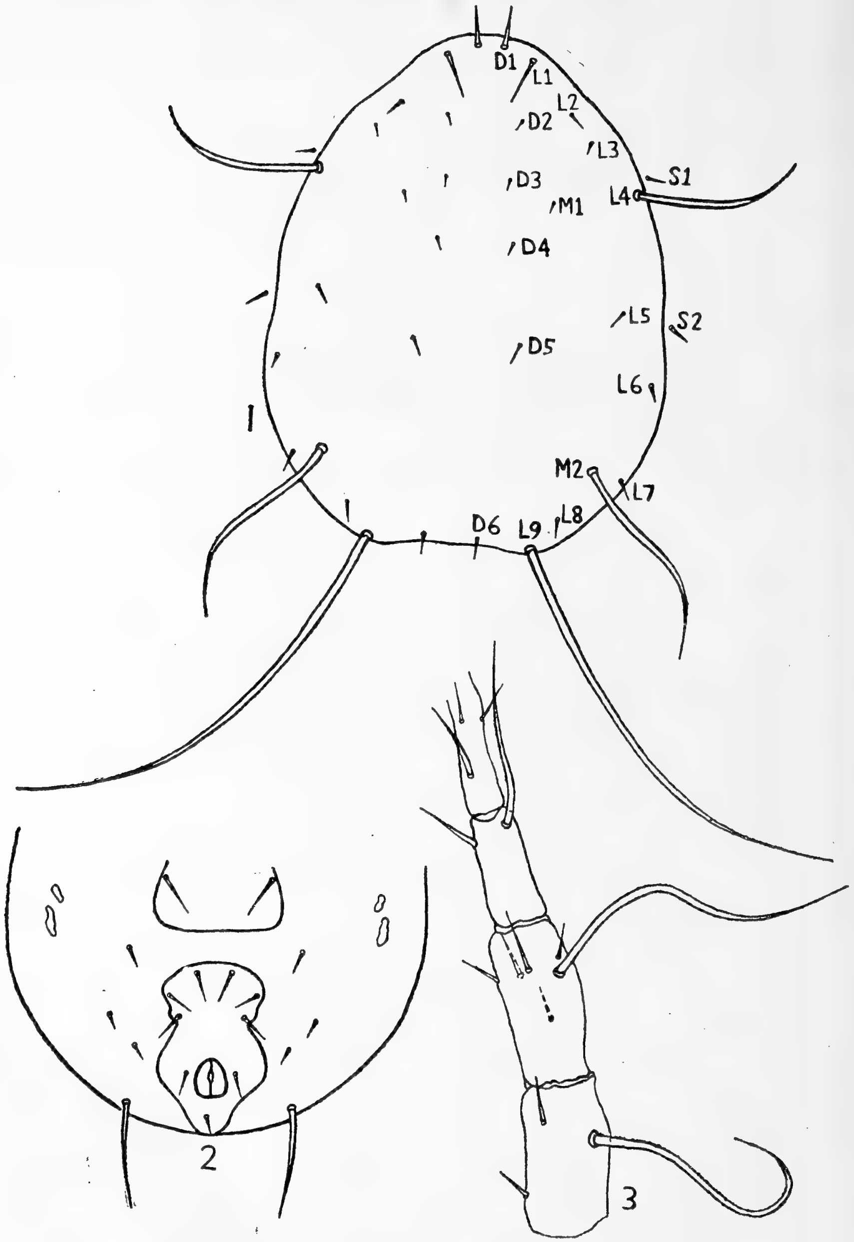
The type material is deposited in the Collections of the Zoological Survey of India, Calcutta.

### **Typhlodromus (Amblyseius) amitae** sp. nov.

Female. Dorsal shield (length 0·304 mm. ; width 0·208 mm.) with 17 pairs of setae i.e., 9 pairs lateral, 6 pairs dorsal, and 2 pairs median series (Fig. 1). Setae L4 0·064-0·072 mm., L9 0·208-0·220 mm. and M2 0·068 mm. long and whip-like. Setae L1, L2, L3, L5, L6, L7 and L8 0·032, 0·008, 0·004, 0·008, 0·012, 0·014 and 0·012 mm. long respectively. Setae D2, D3, D4, and M1 equal in length (0·004 mm.). Setae D1 varying in length (0·024-0·028 mm.). Both D5 and D6 0·008 mm. long. All sacral setae : S1 and S2 0·012 mm. in length and lying on interscutal membrane.

Sternal shield with usual pairs of setae and posteriorly concave. Metasternal seta lying on discrete platelet. Genital shield wedge-shaped,

truncate posteriorly, and with a pair of marginal setae. Ventri-anal shield (long 0·092 mm.; wide 0·060 mm.) vase-shaped, with lateral




**Typhlodromus (Amblyseius) amitae** sp. nov.

FIGS. 1-3. Female: 1. dorsum, L1-9 setae of lateral series, D1-6 setae of dorsal series, M1-2 setae of median series, S1-2 sacral setae; 2. part of posterior venter; 3. genu, tibia and tarsus of leg IV.

margins constricted (Fig. 2) and forming a waist, then flaring to make shield to be widest opposite anus, and bearing 3 pairs of pre-, 1 pair of par-and a post-anal setae. Four pairs of setae present on interscutal membrane surrounding ventri-anal shield. Two pairs of metapodal plates present. Post-stigmatal extension of peritrematal shield slightly encircling coxa IV ; and peritreme anteriorly extending on to dorsum and almost meeting in mid-line.

Legs with ambulacra. Leg IV with macrosetae (Fig. 3).

MALE. Unknown.

*Locality :* The holotype female, and two paratype females on *Hibiscus* sp. (lower side of leaves, mainly by the midrib), Sitala, Sonarpur, 24 Parganas District, West Bengal, Dr. S. K. Bhattacharyya, 18-5-1963.

*Remarks :* Similar to *T.* (*A.*) *schusteri* Chant, 1959, but differing in the relative lengths of some lateral setae (L3 half the length of L2), together with the shape of the ventri-anal shield.

This species is named after the author's sister Miss Amita Bhattacharyya, who helped me in making collections.

## **Phytoseius (Dubininellus) indicus** sp. nov.

FEMALE. Dorsal shield (length 0·260 mm. ; width 0·136 mm.) with 15 pairs of setae, i.e. 8 pairs lateral, 3 pairs dorsal, and one pair each of median, anterior sublateral, verticals, and clunals (Fig. 1). Setae L2, D1-D3, M1 and clunals short and simple ; L4 short and slightly serrate ; the remaining setae stout and serrate. Measurements of setae as follows : verticals 0·020 mm., D1 0·008 mm., D2 0·006-0·012 mm., D3 0·010-0·012 mm., M1 0·008 mm., L1 0·022 mm., L2 0·010-0·012 mm., L3 0·026-0·028 mm., L4 0·010 mm., L5 0·060-0·068 mm., L6 0·060-0·068 mm., L7 0·048-0·052 mm., L8 0·052 mm., clunals 0·008 mm., and anterior sublaterals 0·030-0·032 mm.

Sternal shield wider than long, with normal 3 pairs of setae. Metasternal seta situated on discrete platelet. Genital shield broad, truncate posteriorly, with a pair of marginal setae. Ventri-anal shield longer than wide, with 3 pairs of pre-anal setae in addition to a pair of par- and a post-anal setae (Fig. 2). Two pairs of setae present on interscutal membrane ; ventrocaudal setae serrate and long. Metapodal plates not discernible. Peritreme almost reaching to vertical seta.

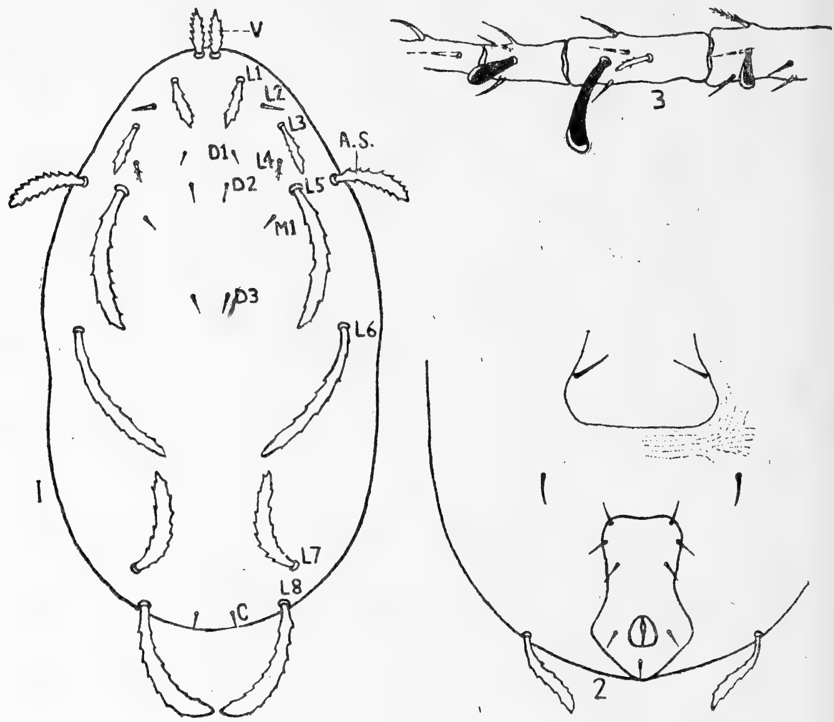
Chelicera of this unique specimen not drawn.

Macrosetae of genu, tibia, and basi-tarsus of leg IV 0·012 mm., 0·032 mm., 0·018-0·020 mm. long respectively (Fig. 3).

MALE. Unknown.

*Locality :* The holotype female from *Hibiscus* sp. leaf, Sitala, Sonarpur, 24 Parganas District, West Bengal, Dr. S. K. Bhattacharyya, 18-5-1963.

*Remarks :* *P.* (*D.*) *indicus* sp. nov. is closely related to *P.* (*D.*) *intermedius* Evans & Macfarlane, 1962, (also see Denmark, 1966) but is dis-




**Phytoseius (Dubininellus) indicus** sp. nov.

FIGS. 1-3. Female : 1. dorsum, L1-8 setae of lateral series, D1-3 setae of dorsal series, A. S. anterior sublateral seta, V vertical seta, C clunal seta ; 2. part of posterior venter ; 3. genu, tibia and tarsus of leg IV.

tinguished from the latter by : seta L2 not serrated and the presence of macrosetae on tibia, tarsus and basi-tarsus of leg IV.

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# Sand dune flora of Western Rajasthan

## 1. Systematic list of trees, shrubs and herbs

BY

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### Introduction

About 60% of the arid region of Western Rajasthan is sandy and a major portion of this is occupied by sand dunes. These dunes are found mostly in Bikaner, Churu, Barmer, Jaisalmer and Jodhpur districts, though scattered patches are also met in Pali, Jalore, Sirohi, Jhunjhunu and Sikar districts.

The pioneering work of Blatter & Hallberg (1918-1921) on the ' Flora of Indian Desert ' mentioned several ecological formations. A biological spectrum was given by Das & Sarup (1951). Sankhala (1951) enumerated the list of plants under various life forms. Agharkar (1952), Sarup & Bhandari (1958) and Joshi (1958) dealt with some ecological aspects of Bikaner. In eastern Rajasthan, Nair & Joshi (1958) contributed to the sand dune ecology of Pilani and its neighbourhood. Recently Shankarnarayan *et al.* (1965) worked out the dune ecology of Osian, but very little study has been made in other regions. The present studies are aimed at making a preliminary record of the flora of some of these sand dunes, based on the plants collected during our surveys.

### Physical Features

Dunes are mainly of three types, longitudinal, transverse and parabolic. While the longitudinal dunes are parallel to the direction of the prevailing winds, transverse dunes are formed on account of obstruction in the path of prevailing winds. The old system consists of dunes of high relief, while those of new system are still in the evolutionary stage and are called embryonic dunes. The windward slope of these dunes is very gentle and quite often cut by short streams, and subjected to wind scouring, while the leeward side is mostly steep.

### Climate

Low, erratic, annual rainfall, seasonal and diurnal fluctuations of temperature and intense solar radiation are characteristic climatic

features of sand dune ecosystem. Scorching heat with dust storms during the summer months and biting cold with dew, mist, and fog during winter months modify the vegetation to a great extent.

The rainfall occurs mainly during July-September. The temperature conditions also vary like the rainfall. Maximum temperature is generally recorded during May when hot winds, *Loo*, blow but the nights are almost always pleasant. Minimum temperature in Bikaner and Jaisalmer districts goes down in winter to freezing and even below freezing point, resulting in heavy frost or dew formation on the dunes. Wind velocity is minimum during November (4·0-5·8 km./hr.) but goes on increasing up to June when it is maximum (12·0-31·0 km./hr.). Humidity is minimum during the period October to March and begins to rise from May onwards and is maximum during August.

## Vegetation

Plants are conservative in their selection of habitat, water requirements etc. and thus may be called indicators of habitats. Every keen naturalist has the experience as to how plants behave differently on various habitat types. Some plants select only the leeward side of the dune, while others may be present on the crest, and still others in the interdune areas and at the base of dunes.

Crests of sand dunes which are active, support plants like *Panicum antidotale*, *P. turgidum*, *Calligonum polygonoides*, *Tephrosia falciformis* and *Cyperus arenarius*. Sand dune tops, where small sand dunes are aggregated, species like *Cyperus arenarius* and *Aristida funiculata* are among the first arrivals and are followed by *Dipterygium glaucum*, *Tephrosia falciformis* and *Capparis decidua*.

On the slopes, the windward side has a better vegetation than the leeward side. Various plants like *Cenchrus* spp., *Aristida* spp., *Lasiurus sindicus*, *Crotalaria burhia*, *Tribulus terrestris*, *Enicostemma verticillatum*, *Arnebia hispidissima*, *Gisekia pharnacoides*, *Indigofera cordifolia*, *Calligonum polygonoides* occupy this region. The leeward side, due to the steep slopes sometimes followed by heavy runoff, supports only a few very hardy species, with least water requirement like *Aerva pseudotomentosa*, *Leptadenia pyrotechnica* etc. There is a profound difference in the composition and frequency of different species found on the two sides of the dunes.

Base of the dune and interdunal areas support luxuriant vegetation with good growth of plant species due to the accumulation of water from the surrounding areas. The common species encountered are *Tecomella undulata*, *Prosopis cineraria*, *Farsetia hamiltonii*, *Polygala erioptera*, *Polycarpaea corymbosa* etc. *Mollugo cerviana*, *Cyperus arenarius*, *Aristida adscensionis*, *A. funiculata*, *Cenchrus biflorus* are some of the

pioneers, which are followed by species like *Cenchrus ciliaris*, *C. prieurii*, *C. pennisetiformis*, *Lasiurus sindicus*, *Panicum antidotale*, *Panicum turgidum*, *Aerva persica*, *A. pseudo-tomentosa*, *Crotalaria burhia* and *Leptadenia pyrotechnica* which firmly hold the sand particles in the mesh of their root system.

## List of Specimens collected

Plants enumerated in the list have been collected from sand dunes in W. Rajasthan and are preserved at the herbarium, Central Arid Zone Research Institute, Jodhpur. Nomenclature of plants is according to latest findings. Flowering season and life forms for each plant have been indicated.

### Cruciferae

**Dipterygium glaucum** Decaisne

6-10 dm. tall, perennial, erect undershrub, with yellow flowers. Common on the windward side of dunes. Fls. Aug.-Nov. (Chamaephyte).

**Farsetia hamiltonii** Royle

3-4 dm. tall, sub-erect, annual herb with pink to white flowers. Often seen at the base of dunes and the interdune areas. Fls. Aug.-Nov. (Therophyte).

### Capparidaceae

**Capparis decidua** (Forsk.) Edgew.

2-4 m. tall, deciduous, spiny shrub; when protected often attains tree-size. Flowers yellow. Common on the windward side and top of the dunes. Fls. Jan.-Aug. rare plants up to Oct. (Phanerophyte).

**Cleome gynandra** Linn.

3-4 dm. tall, erect, annual herb with yellow flowers. Mostly found around the base of dunes and in interdune areas. Fls. Aug.-Dec. (Therophyte).

**Cleome viscosa** Linn.

2-4 dm. tall, erect, annual herb with yellow flowers. Found mostly at the base of dunes and in the interdune areas. Fls. July-Nov. (Therophyte).

### Polygalaceae

**Polygala erioptera** DC.

2-3 dm. tall, erect to sub-erect, annual herb with pinky-mauve or yellow flowers. Found on the base of the dunes and interdune area. Fls. Aug.-Nov. (Therophyte).

### Caryophyllaceae

**Polycarpaea corymbosa** (L.) Lamk.

1·5-2·5 dm. long, erect, annual herb with white flowers having a pinkish tinge. Common on interdune areas and leeward side of the dunes. Fls. Aug.-Nov. (Therophyte).

### Malvaceae

**Sida ovata** Forsk.

5-6 dm. tall, erect, perennial undershrub with pale-yellow flowers. Frequent on the interdune areas. Fls. Aug.-Nov. (Chamaephyte).

### Sterculiaceae

**Melhania denhamii** R.Br.

About 1 m. tall, bushy perennial with yellow flowers. Frequent on hill-side dunes. Fls. Aug.-Dec. (Chamaephyte).

### Tiliaceae

**Corchorus depressus** (Linn.) Christensen

1·5-2·0 dm. long, prostrate, perennial herb with yellow flowers. Frequent on interdune areas. Fls. Aug.-Nov. (Chamaephyte).

**C. tridens** Linn.

3-4 dm. tall, erect, annual herb with yellow flowers. Frequently on the windward side of dunes. Fls. Aug.-Nov. (Therophyte).

**Grewia tenax** (Forsk.) Fiori

1·0-1·5 m. tall shrub with yellow flowers. Frequent on hill-side dunes. Fls. July-Nov. (Nanophanerophyte).

### Zygophyllaceae

**Fagonia cretica** Linn.

1·5-2·0 dm. tall, spiny undershrub with pink flowers, rarely white. Common on interdune areas and hill-side dunes. Fls. July-Nov. (Therophyte).

**Tribulus alatus** Del.

1-3 dm. long, sub-erect, prostrate, annual herb with yellow flowers. Common on the windward side of the dunes and also on the top of stabilized dunes. Fls. Aug.-Dec. (Therophyte).

**T. terrestris** Linn.

2-4 dm. long, prostrate-suberect, annual herb with yellow flowers. Common on the windward sides and top of the stabilized dunes. Fls. Aug.-Dec. (Therophyte).

### SIMAROUBACEAE

**Balanites aegyptiaca** (Linn.) Del.

3-4 m. tall, thorny shrub with greenish-white flowers. Common on hill-side dunes. Fls. April-Sept. (Phanerophyte).

### CELASTRACEAE

**Maytenus emarginata** (Willd.) Ding Hou

3-4 m. tall, deciduous, thorny tree with white flowers. Common on the hill-side dunes and interdune areas. Fls. Oct.-March (Phanerophyte).

### RHAMNACEAE

**Zizyphus nummularia** (Burm. f.) Wight & Arn.

1-2 m. tall, bushy shrub, sometimes large like a tree with greenish white flowers. Common on hill-side dunes and interdune areas. Fls. Sept.-March (Nanophanerophyte).

### FABACEAE

**Crotalaria burhia** Buch.-Ham. ex Benth.

0·5-1·5 m. tall, erect, perennial shrub with yellow flowers. Common on the leeward and windward sides and on interdune areas. Fls. Oct.-March (Chamaephyte)

**Indigofera caerulea** Roxb.

4-6 dm. tall, erect, perennial shrub with pinkish flowers. Frequent on the interdune areas. Fls. Aug.-Jan. (Chamaephyte).

**I. cordifolia** Heyne ex Roth.

15-25 cm. long, prostrate to sub-erect, annual herb with bright red flowers. Common on interdune areas and the windward slopes of dunes. Fls. Aug.-Dec. (Therophyte).

**I. hochstetteri** Baker

3-4 dm. long, sub-erect, annual herb with pink flowers. Common on interdune areas. Fls. Aug.-Dec. (Therophyte).

**I. linifolia** (L.f.) Retz.

2-3 dm. long, prostrate, annual herb with bright red flowers. Common on the hill-side dunes and frequent on the windward slopes and interdune areas. Fls. Aug.-Dec. (Therophyte).

**I. linnaei** Ali

1·0-3·0 cm. long, prostrate-suberect, annual herbs with pink red flowers ; frequent on windward side of stable sand dunes, interdune areas. Fls. Jan.-March (Therophyte).

**Phaseolus trilobus** (L.) Ait.

3-6 dm. long, erect-climbing, annual herb with yellow flowers. Frequent on the windward side of dunes and also on cultivated dunes. Fls. Aug.-Nov. (Therophyte).

**P. aconitifolius** Jacq.

3-6 dm. long, suberect-climbing, annual herb with yellow flowers. Frequent on cultivated dune slopes. Fls. Aug.-Nov. (Therophyte).

**Tephrosia falciformis** Ramaswamy

6-9 dm. tall, erect, perennial herb with pinkish violet or rosy flowers. Common on top of sand dunes, and on the windward and leeward sides. Fls. Aug.-Nov. (Hemicryptophyte).

**T. purpurea** (L.) Pers.

4-6 dm. tall, erect, perennial herb with pink-violet flowers. Common on the windward side and interdune areas. Fls. Aug.-Nov. (Hemicryptophyte).

**T. villosa** (Linn.) Pers.

4-6 dm. tall, erect, perennial undershrub with pinkish violet flowers. Frequent on the windward slope of the dunes. Fls. Aug.-Dec. (Hemicryptophyte).

## Mimosaceae

**Acacia jacquemontii** Benth.

1·5-3 m. tall, bushy shrub with yellow flowers in globose heads. Frequent on the slopes of the dunes. Fls. Jan.-June (Phanerophyte).

**A. nilotica** (Linn.) Delile ssp. **indica** (Benth.) Brenan

3-5 m. tall, thorny tree with yellow flowers in terminal heads. Common in the interdune areas only, not on the dunes. Fls. Sept.-May (Phanerophyte).

**A. senegal** (L.) Willd.

3-6 m. tall, prickly tree with white flowers. Common on top of hill-side dunes. Fls. April-May (Phanerophyte).

**Prosopis cineraria** (Linn.) MacBride

3-6 m. tall, spiny tree with yellow flowers in spikes. Common on the top, slope and base of dunes and in interdune areas. Fls. Oct.-May (Phanerophyte).

**P. juliflora** (Sw.) DC.

2·5-4 m. tall, spiny tree with yellow flowers. Completely naturalised in the area, native of Mexico. On interdune areas especially. Fls. Oct.-May (Phanerophyte).

### Cucurbitaceae

**Citrullus colocynthis** (L.) Schrad.

1-2 m. long, annual, trailing herb with yellow flowers. Common on the windward slopes, interdune areas and sandy hummocks. Fls. Sept.-Dec. (Therophyte).

**Cucumis myriocarpus** Naud.

1-2 m. long, annual trailer or climber with yellow flowers. Common on the windward slopes and tops of dunes. Fls. Aug.-Oct. (Therophyte).

**C. pseudo-colocynthis** Royle

1-1·5 m. long, annual trailer or climbing herb with yellow flowers. Common on slopes and base of dunes. Fls. Aug.-Oct. (Therophyte).

**Mukia maderaspatana** (L.) M. Roem.

1-2 m. long, climbing, annual herb with yellow flowers. Frequent on shrubs and trees in the interdune areas and on the windward slopes. Fls. Aug.-Oct. (Therophyte).

### Molluginaceae

**Gisekia pharnaceoides** Linn.

1·5-2·5 dm. tall, erect, annual, psammophytic herb with white flowers. Common on the windward slopes and interdune areas. Fls. Aug.-Nov. (Therophyte).

**Mollugo cerviana** (L.) Ser.

1-2 dm. tall, erect herb with greenish-white flowers. Common on tops of dunes and interdune areas. Fls. Aug.- Nov. (Therophyte).

**M. nudicaulis** Lamk.

2-3 dm. tall, erect, annual herb with white flowers. Frequent on the windward slopes and interdune areas. Fls. Aug.-Nov. (Therophyte).

**Trianthema govindia** Buch. Ham. ex DC.

3-4 dm. long, prostrate, annual herb with dark red flowers. Common on slopes and interdune areas. Fls. Aug.-Nov. (Therophyte).

## RUBIACEAE

**Borreria articularis** (L.f.) F.N. Will.

2-3 dm. tall, erect to decumbent, annual herb with pinkish-white flowers. Common on interdune areas. Fls. Aug.-Nov. (Therophyte).

## COMPOSITAE

**Echinops echinatus** Roxb.

3-5 dm. tall, erect, annual, spiny herb with white flowers. Frequent on interdune areas. Fls. Feb.-June (Therophyte).

**Pulicaria angustifolia** DC.

3-4 dm. tall, erect, annual herb with yellow flowers. Common on interdune areas and sandy hummocks. Fls. Aug.-Dec. (Therophyte).

**P. wightiana** (DC.) Benth. ex Clarke

4-8 dm. tall, sub-erect, woody, perennial herb with yellow flowers. Common on interdune areas. Fls. Aug.-Dec. (Chamaephyte).

## SALVADORACEAE

**Salvadora oleoides** Decaisne

8-15 m. tall, evergreen tree with white flowers. Common on all types of dunes and interdune areas. Fls. Feb.-April (Phanerophyte).

## ASCLEPIADACEAE

**Calotropis procera** (Ait.) R. Br.

1-1·5 m. tall, erect, perennial herb with violet flowers. Common on dunes and interdune areas. Fls. Sept.-Dec. (Chamaephyte).

**Leptadenia pyrotechnica** (Forsk.) Decaisne

1-2 m. tall, much branched, leafless, perennial bush with pale yellow flowers. Common on the windward side and top of the dunes and on the interdune areas. Fls. Aug.-Dec. (Nanophanerophyte).

### GENTIANACEAE

**Enicostemma hyssopifoliium** (Willd.) Verdoon

2-4 cm. tall, erect, decumbent, perennial herb with yellow flowers. Frequent on windward side of hill-side dunes. Fls. Aug.-Oct. (Hemicryptophytes).

### BORAGINACEAE

**Arnebia hispidissima** (Lehm.) DC.

2-3 dm. tall, erect, strigose, perennial undershrub with yellow flowers. Frequent on all types of dunes. Fls. Oct.-Jan. (Cryptophyte).

**Sericostomma pauciflorum** Stocks

2-3 dm. tall, erect, perennial undershrub with white flowers. Common on hill-side dunes. Fls. Oct.-Jan. (Chamaephyte).

### CONVOLVULACEAE

**Convolvulus microphyllus** Sieb. ex Spreng.

3-4 dm. tall, sub-erect or climbing, annual herb with pinkish white flowers. Sometimes on interdune areas. Fls. Aug.-Nov. (Therophyte).

**Evolvulus alsinoides** (L.) L.

1·5-2·0 dm. long, prostrate, annual herb with blue-purple flowers. Frequent on dune slopes. Fls. Aug.-Dec. (Therophyte).

**Ipomoea sindica** Stapf.

4-8 dm. tall, climbing, annual herb with white flowers. On cultivated dunes. Fls. Aug.-Oct. (Therophyte).

**I. pes-tigridis** Linn.

1-1·5 m. long, twining or spreading, annual, hispid herb with white or pinkish white flowers. Frequent on hedges in interdune areas. Fls. Sept.-Oct. (Therophyte).

### SOLANACEAE

**Lycium barbarum** Linn.

1-2 m. tall, spiny, perennial shrub with white flowers. Common on all types of dunes and on interdune areas. Fls. Oct.-March (Phanerophyte).

**Solanum surattense** Burm. f.

3-4 dm. tall, erect, much branched, perennial under-shrub with pinkish purple flowers. Frequent on dune slopes and interdune areas. Fls. June-March (Chamaephyte).

### OROBANCHACEAE

**Cistanche tubulosa** Wight

3-5 dm. tall, erect perennial herb with pinkish-violet flowers. Root parasite on *Salvadora*. Fls. Nov. (Cryptophyte).

### BIGNONIACEAE

**Tecomella undulata** (Sm.) Seem.

2-3 m. tall, deciduous tree with yellow or orange red flowers. Common on interdune areas. Fls. Jan.-March (Phanerophyte).

### PEDALIACEAE

**Pedalium murex** Linn.

1·5-4 dm. tall, erect, much branched annual with yellow flowers. Frequent on dune slopes and interdune areas. Fls. Aug.-Oct. (Therophyte).

### ACANTHACEAE

**Blepharis linearifolia** Pers.

1·5-3 dm. long, sub-erect, perennial herb with violet-blue flowers. Frequent on hill-side dunes. Fls. Aug.-Sept. (Cryptophyte).

### VERBENACEAE

**Clerodendrum multiflorum** (Burm. f.) Retz.

1-2 m. tall, perennial shrub with white flowers. Frequent on dune slopes and often used in hedges. Fls. Aug.-Nov. (Nanophanerophyte).

### LABIATAE

**Leucas cephalotes** (Roth.) Spreng.

3-6 dm. tall, erect annual with white flowers. Common on interdune areas and near fields. Fls. Aug.-Oct. (Therophyte).

### Nyctaginaceae

**Boerhavia diffusa** Linn.

6-10 dm. long, trailing, prostrate, perennial herb with pink flowers. Frequent in interdune areas. Fls. Major part of the year (Hemicryptophyte).

### Amaranthaceae

**Aerva persica** (Burm. f.) Merr.

5-10 dm. tall, erect, perennial herb with greenish white flowers. Common on leeward and windward sides of dunes, also on interdune areas. Fls. Aug.-Dec. (Hemicryptophyte).

**A. pseudo-tomentosa** Blatt. & Hall.

8-15 dm. tall, erect perennial with greenish white flowers. Common on the windward and leeward sides of dunes. Fls. Aug.-Dec. (Hemicryptophyte).

**Digera alternifolia** (L.) Aschers.

3-4 dm. tall, erect, annual herb with pink or rosy flowers. Frequent in interdune areas. Fls. April-Dec. (Therophyte).

**Pupalia lappacea** (L.) A. Juss.

1-1·5 m. tall, straggling, perennial herb with pale green flowers. Frequent in interdune areas. Fls. Aug.-March (Hemicryptophyte).

### Polygonaceae

**Calligonum polygonoides** Linn.

1·5-2·0 m. tall perennial, leafless shrub with pink flowers. Common on dune tops and interdune areas. Fls. Feb.-June (Nanophanerophyte).

### Euphorbiaceae

**Euphorbia clarkeana** Hook. f.

1-2 dm. long, sub-erect, annual herb with greenish white flowers. Frequent in the interdune areas. Fls. Aug.-Sept. (Therophyte).

**E. granulata** Forsk.

1·0-1·5 dm. long, prostrate, annual herb with pink flowers. Frequent on stabilised dunes. Fl. and Fr. Oct.-Feb. (Therophyte).

### Cyperaceae

**Cyperus arenarius** Retz.

1-2 dm. tall, erect, perennial sedge. Common on the top of sand dunes and sandy hummocks. Fls. Aug.-Dec. (Cryptophyte).

**C. bulbosus** Vahl.

2-3 dm. tall, erect, rhizomatous sedge ; spikes brown-red. Frequent in the interdune areas. Fls. Aug.-Dec. (Hemicryptophyte).

**C. conglomeratus** Rottb.

2-3 dm. tall, erect, perennial, rhizomatous sedge. Spikelets white. Common on windward slopes and interdune areas. Fls. Aug.-Dec. (Hemicryptophyte).

**C. rotundus** Linn.

2-4 dm. tall, erect, perennial, rhizomatous sedge with dark-red spikelets. Frequent on interdune areas and base of dunes. Fls. Aug.-Dec. (Hemicryptophyte).

## POACEAE

**Aristida adscensionis** Linn.

3-5 dm. tall, erect, annual grass. Common on the windward and leeward slopes and interdune areas. Fls. Sept.-Jan. (Therophyte).

**A. funiculata** Trin. et Rupr.

3-6 dm. tall, erect annual. Common on the dune slopes and interdune areas. Fls. Sept.-Jan. (Therophyte).

**A. hirtigluma** Steud. ex Trin. et Rupr.

3-5 dm. tall, erect, annual. Common on dune slopes and interdune areas. Fls. Sept.-Dec. (Therophyte).

**A. pogonoptila** (Jaub. et Spach.) Boiss.

3-6 dm. erect, tufted perennial. Common on the slopes and top of dune. Fls. Sept.-Feb. (Hemicryptophyte).

**Cenchrus biflorus** Roxb.

1-3 dm. tall, sub-erect, annual grass. Common on loose sands and hummocks and dune tops. Fl. Aug.-Jan. (Therophyte).

**C. ciliaris** Linn.

1-3 dm. tall, sub-erect, biennial or perennial grass. Common on dune slopes and in interdune areas. Fls. Aug.-Jan. (Hemicryptophyte).

**C. pennisetiformis** Hochst. ex Steud.

4-6 dm. tall, erect, perennial, tussocky grass. Common on dune slopes of mobile sand dunes. Fls. Sept.-Feb. (Hemicryptophyte).

**C. prieurii** (Kunth) Maire

2·5-4·5 dm. tall, sub-erect, annual grass. Common on dune slopes and on interdune areas. Fls. Sept.-Feb. (Therophyte).

**C. setigerus** Vahl

2-4 dm. tall, erect, perennial grass. Common on dune slopes and on interdune areas. Fls. Aug.-Jan. (Hemicryptophyte).

**Cymbopogon jwarancusa** (Jones) Schult.

6-10 dm. tall, erect, perennial, tussocky grass. Common on dune slopes and on interdune areas. Fls. Aug.-Nov. (Chamaephyte).

**Dactyloctenium aegyptium** (L.) P. Beauv.

3-5 dm. erect, stoloniferous, perennial grass. Common on dune base and stabilized sand dunes. Fls. Aug.-Feb. (Therophyte).

**Eragrostis ciliaris** (L.) R. Br.

1·5-2·5 dm. tall, erect grass. Frequent on interdune areas. Fls. Aug.-Dec. (Therophyte).

**E. tenella** (L.) P. Beauv.

3-4 dm. tall, erect, annual grass. Frequent in the interdune areas. Fls. Aug.-Nov. (Therophyte).

**E. tremula** Hochst. ex Steud.

3-4 dm. tall, erect, annual grass. Frequent in interdune areas and on sandy hummocks. Fls. Aug.-Nov. (Therophyte).

**Lasiurus ecaudatus** Saty. et Shank.

6-10 dm. tall, erect, perennial, tussocky grass. Common on dune slopes and interdune areas. A good sand binder. Fls. Aug.-Dec. (Therophyte).

**Panicum antidotale** Retz.

1-1·5 m. tall, erect, perennial grass. Very common on the crest and leeward slope of the dune. A good sand binder. Fls. Aug.-Dec. (Chamaephyte).

**P. turgidum** Forsk.

1-1·5 m. tall, erect, perennial, tussocky grass. Common on the top and dune slopes. Fls. Aug.-Nov. (Chamaephyte).

**Perotis hordeiformis** Nees apud Hook. et Arn.

2-4 dm. tall, erect, annual grass. Common on the interdune areas. Fls. Aug.-Dec. (Therophyte).

## Statistical Synopsis of Sand Dune Flora

Out of 58 families, 226 genera and 440 species recorded as indigenous in Western Rajasthan, 35 families covering 62 genera and 93 species are available from sand dunes of the area. Of these the families having two or more genera are : Cruciferae (2), Capparidaceae (2), Tiliaceae (2), Zygophyllaceae (2), Papilionaceae (4), Mimosaceae (2), Asclepiadaceae (2), Convolvulaceae (3), Solanaceae (2), Amaranthaceae (2) and Gramineae (8), while only the following families are represented by four or more species : Papilionaceae (11), Mimosaceae (5), Cucurbitaceae (4), Ficoideae (4), Convolvulaceae (4), Amaranthaceae (4), Cyperaceae (4) and Gramineae (17). The maximum number of genera and species are that of Gramineae (8 and 17) in this land-form. Family Compositae with 33 species, which comes next in rank to Gramineae in the flora of Western Rajasthan, lags behind in the dune flora and so also is the case with Cyperaceae.

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# A Catalogue of the Birds in the Collection of the Bombay Natural History Society—3

## Falconiformes

BY

HUMAYUN ABDULALI

[*Continued from Vol.* **65** (2) : 430]

The first volume of the HANDBOOK OF THE BIRDS OF INDIA AND PAKISTAN was published (July 1968) after the manuscript of this part had been got ready for the press. An attempt has been made to incorporate in the text necessary references to the HANDBOOK. Measurements cited in the text are generally from the FAUNA; where such measurements are reproduced in the HANDBOOK, it has not been considered necessary to substitute a reference to the HANDBOOK. Measurements preceded by the letters IH are taken from the HANDBOOK.

The serial numbers in the HANDBOOK are identical with those in the SYNOPSIS, and so a separate reference was not found necessary.

As some of the buzzards and eagles are difficult to identify, even down to species, it is possible that in spite of every care some of the specimens in the collection are incorrectly identified. It is hoped that it will be possible at some future time to examine them once more along with additional material from the Indian Region and some reliably identified specimens for comparison.

This part deals with 846 specimens including all up to Register No. 23041.

124 **Elanus caeruleus vociferus** (Latham) (Coromandel Coast)
Black-winged Kite **5**: 125

28 : 15 ♂♂ 11 ♀♀ 2 o ? (9 juv.)

2 Chitral, N.W.F.P.; 2 Ambala, 1 Bahawalpur, 1 Wazirabad, Punjab; 1 Delhi; 1 Gwalior; 3 Gujerat; 2 Nasik, 3 Bombay, 1 Thana, 1 Ratnagiri, Maharashtra; 1 Coorg, Mysore; 1 Orissa; 1 Bulandshahr, U.P.; 1 Nepal; 3 Tirhut, Bihar; 2 Imphal, Assam; 1 *Henzada, Burma.*

The females are not very appreciably larger than the males but specimens from the neighbourhood of Bombay and southwards have slightly smaller wings and tails than those from the north. The few

larger specimens included among the southern birds may well be non-breeding migrants.

| | | Wing (IH 260-276) | Tail (IH 116-124) |
|---|---|---|---|
| 7 northern | ♂♂ | 267-282 av. 274 | 118-123 av. 121 |
| 2 southern | ♂♂ | 251, 266 | 115, 116 |
| 6 northern | ♀♀ | 273-281 av. 276.5 | 122-126 av. 124.6 |
| 3 southern | ♀♀ | 262, 265, 273 | 116, 118, 121 |
| 3 northern | ♂♂ juv. | 251, 252, 273 | 123, 124, 132 |
| 2 southern | ♂♂ juv. | 240, 270 | 120, 129 |
| 3 northern | ♀♀ juv. | 262, 273, 276 | 128, 132, 133. |

It appears very curious that some, both male and female, in juvenile plumage, in addition to having wings as large as adults, have even longer tails.

125 **Aviceda jerdoni jerdoni** (Blyth) (Malacca) Blyth's Baza **5**: 174

1 ♀ Kurseong. Wing 338.

126 **Aviceda jerdoni ceylonensis** (Legge) (Near Kandy, Ceylon) **5**: 175

nil.

127 **Aviceda leuphotes leuphotes** (Dumont) (Pondicherry) Indian Blackcrested Baza **5**: 171

1 o? Coonoor. Wing 230, wing tip 68.

128 **Aviceda leuphotes syama** (Hodgson) (Lower region of Nepal)

5 : 1 ♀ 4 o? (1 fragmentary)
1 Bastar, M.P. ; 1 Nepal ; 2 Darjeeling ; 1 *Upper Burma.*

With the material available, it is not possible to separate the races, so the specimens are listed in accordance with the distribution in SYNOPSIS and IND. HANDBOOK. Deignan (*Auk* 1948 : 248) indicates that the northern birds *syama* (Nepal, Assam, north Burma, and parts of China) migrating south to Siam, Malaya and possibly Ceylon, have a longer wingtip (80-87) than the southern residents. In the present series the wingtip is 60 (Upper Burma), 72, 76, 85, 95 (Bastar, M.P.). The last relates to a very damaged wing and may be incorrect.

129 **Pernis ptilorhyncus orientalis** Taczanowski (Eastern Siberia) Honey Buzzard **5**: 168

1 o? *Chin Hills, Burma.*

This one unsexed specimen, a very ragged skin (No. 12712) obtained in November (wing 444), differs from all the others in the brown of the underparts extending on to and replacing the grey on the undersurface

of the tail. The specimen was sent to Dr. Amadon who thought it was of this race.

*Orientalis* was included in the FAUNA as a race of *apivorus*. In this specimen and in a ♂ *ruficollis* (No. 12708, Wazirabad, Punjab), the outer webs of the primaries are emarginated from the second to the fifth (and not the sixth as in the other *Pernis* available), a character of *apivorus* (Vaurie 1965 : 145). In the course of recent correspondence Dr. Amadon said: 'As to the wing emargination, I suspect that it varies'.

In IND. HANDBOOK, in addition to a general statement that it is an uncommon winter migrant to northern India, it is said that it has occurred as far south as Ceylon, and reference is made to a record in *Loris*. This is a mere quotation from 'Bird Club Notes' which reads: 'Specimen obtained at Mannas', with nothing to show how and by whom this difficult identification was made. More recently Phillips records one from the Maldives (*JBNHS* **60** : 569). Vaurie, 1962, *Amer. Mus. Novitates* 2111, p. 6, refers to specimens from Margherita, Assam, and Bengal.

130 **Pernis ptilorhyncus ruficollis** Lesson ("Patrie inconnue"=Bengal)
Honey Buzzard **5**: 167

24 : 10 ♂♂ 7 ♀♀ 7 o ? 12 adults (underparts brown) ; 9 juvenile (underparts white with dark streaks) ; 1 all white below ; 2 barred.

2 Ambala, 1 Hissar, 1 Wazirabad, 1 Bahawalpur, Punjab ; 2 Radhanpur, N. Gujerat ; 2 Bhuj, Kutch ; 1 Chikalda, Berar ; 1 Thana, 1 Khandala, 1 Bombay, Maharashtra ; 1 Karwar, Mysore ; 1 Coonoor, 1 Ootacamund, 1 Palnis, Madras ; 1 Vizagapatnam, A.P. ; 1 Agra, 1 Shahjehanpur, U.P. ; 1 Bihar (?) ; 1 Calcutta ; 1 Godavari, Nepal ; 1 no data.

Only one of the specimens available is separable as *orientalis* and the wings, though larger than indicated in the FAUNA, are within the limits of this race in Vaurie (1965 : 149) :

10 ♂♂ 377-447 av. 402 (Vaurie 366-450 av. 401·3)*.
7 ♀♀ 386-425 av. 403 (Vaurie 387-432 av. 410).

* The range in the IND. HANDBOOK, 382-417, appears to be in error.

There is considerable variation in the plumage of apparently adult birds and it has been customary to suggest that the species is polymorphic, some being all brown below and others almost white. Stuart Baker stated that all *ruficollis* when fully adult assume an all-brown plumage. Kirke Swann (MONOGRAPH OF BIRDS OF PREY **2** : 313) also indicates no colour differences between the sexes. It is, however, noteworthy that only one of the eight all-brown (kite-like) birds (with broad black and grey bars on the tail) which have been sexed is marked a female. Again, excluding this specimen (No. 12718), all the other females are white below with streaks on the breast and with narrowly

barred tails. All the females have the pale bands on the tail more distinctly crossed by wavy lines, which are almost absent in the males.

The largest-winged (447) male, from Karwar, is a very pale (almost white) rufous below, while two others (one ♂, one unsexed) show brown barring on the breast which appears to be a stage towards the all-brown underparts, which latter together with the grey around the head I am inclined to accept as the plumage of the adult male.

131 **Milvus milvus milvus** (Linnaeus) (South Sweden) Kite

nil.

132 **Milvus migrans migrans** (Boddaert) (France) 5 : 121

4 ♀♀

1 *Sheikh Saad*, 1 *Shaiba*, 1 ? *Mesopotamia* ; 1 Kalat, Baluchistan.

The races of this species have been difficult to determine. The Mesopotamian birds were identified as of the nominate form by Ticehurst but in the summary of the specimens examined by him (*JBNHS* **28** : 425) the sexes differ from those on the present labels. Only No. 12465 from Kalat has a distinctly whitish head with black streaks. It has no white under the primaries, as in *lineatus* :

Wing 443, 458, 461, 463.

133 **Milvus (migrans) govinda** Sykes (Dukhun) Pariah Kite 5 : 121

19 : 5 ♂♂ 7 ♀♀ 7 o ? (2 pull., 1 chick).

1 Palanpur, 1 Gir, 1 Bhavnagar, Gujerat ; 1 Panchgani, 10 Bombay, Maharashtra ; 1 Nilambur, Kerala; 1 Vizagapatnam, A.P. ; 1 Jainagar, 1 Baghowni, Bihar ; 1 Mussoorie, U.P.

There are many differences in colour between the specimens and it is possible that a well-collected series would explain some of them. The sexes do not show much difference in size :

| | | | | | | |
|---|---|---|---|---|---|---|
| Wing | 4 ♂♂ | 420-446 | av. 436 | 6 ♀♀ | 419-444 | av. 431·5 |
| Tail | | 233-262 | av. 249 | | 243-276 | av. 249 |

IND. HANDBOOK refers to its occurrence in the Andaman Islands, but I have already (*JBNHS* **61** : 506) indicated that this is probably based on birds carried down by boat.

134 **Milvus (migrans) lineatus** (Gray) (China) Blackeared Kite 5 : 134

9 : 6 ♂♂ 2 ♀♀ 1 o ?

1 *Yarkand* ; 1 Chitral ; 1 Simla ; 1 Srinagar ; 1 Bhayander, Bombay, 1 Lonavla, 1 Bhimashanker, Poona, Maharashtra ; 1 Annandapuram, Shimoga, Mysore ; 1 *Burma*.

Wing 6 ♂♂ 471-507 av. 487 2 ♀♀ 471, 477.

The two females from Srinagar (No. 12470) and Simla (No. 19049) are smaller than the males and may well be *govinda* as originally marked

on the labels. They are included here for the white patches under the wings. The specimen from Shimoga, Mysore, is the southernmost record of this species (*JBNHS* **65** : 774)

135 **Haliastur indus indus** (Boddaert) (Pondicherry) Brahminy Kite **5 : 118**

17 : 4 ♂♂ 10 ♀♀ 3 o ? (8 in adult plumage).

2 Punjab ; 1 Kronthal ; 1 Bhavnagar, 1 Baroda, Gujerat ; 2 Bombay, 1 Panvel, Maharashtra ; 3 North Kanara ; 2 Kerala ; 1 Tiruchirapalli, Madras ; 1 Nepal ; 1 Siliguri ; 1 Calcutta.

The white feathers of the head, nape, and breast have black shaft streaks. In 7 adults obtained between 16 January and 25 May, the feathers of the nape are worn at the tips, leaving bare shaft tips in some cases almost an inch in length ; in three others collected in August, September, and November these feathers are normal :

Wing 2 ♂♂ 373, 380 (IH 359-394) 6 ♀♀ 379, 390, 397, 403, 404, 408 (IH 379-403)

These notes and measurements include two specimens which are not in the collection.

EL **Accipiter gentilis gentilis** (Linnaeus) (Dalscarlian Alps) Goshawk **5 : 145**

1 ♀ *Pottenstein, Germany.*

136 **Accipiter gentilis schvedowi** (Menzbier) (Transbaikalia) **5 : 146**
nil.

137 **Accipiter badius cenchroides** (Severtzov) (Lower Syr-Darya ; Russian Turkestan) Central Asian Shikra **5 : 150**

4 : 1 ♂ juv., 3 ♀♀

1 *Shiraz, Iran* (wing 201) ; 1 *Ziarat, Persian Baluchistan* (190) ; 2 Bombay (220, 223).

The two females from Bombay (Nos. 12630 and 12645) were taken in October and November and, together with the one from Ziarat, are separable from the others by the paleness of the upper parts. The first two were named *cenchroides* by H. G. Deignan when he examined them in Bombay many years ago. The juvenile male from Shiraz is no different from others (*dussumieri*) from India. Though *cenchroides* is accepted as larger than *dussumieri* the wing measurements overlap to a great extent and, except for the above specimens, I am listing all the specimens from Indian limits as *dussumieri*. The two specimens from Bombay extend the known range of this race.

With a series of breeding birds, it may be possible to determine two separate groups but I am unable to do anything with the present series.

138 **Accipiter badius dussumieri** (Temminck) (Bengal) Shikra **5 : 149**

69 : 34 ♂♂ 30 ♀♀ 5 o ?

1 Kalat, Baluchistan ; 1 Wana, 1 Bhagat State, N.W.F.P. ; 3 Simla, 1 Pathankot, 1 Jagadhri, 1 Patiala, 2 Ambala, 1 Jullunder, 2 Chandigarh, 1 Chamba ;

1 Wazirabad ; 1 Delhi ; 1 Jodhpur, Rajasthan ; 2 Kutch, 1 Jasdan, 7 Bhavnagar, 1 Anand, 1 Cambay, 1 Palanpur, Gujerat ; 1 Melghat, Berar ; 1 Saugor ; 9 Bombay, 1 Kihim, Kolaba, 2 Khandala, 1 Ratnagiri, 2 Satara, 1 Nagpur, Maharashtra ; 2 North Kanara, Mysore ; 1 Palni ; 1 Jamestown, Kanyakumari, 1 Madras ; 1 Kumili, 1 Edanad, Travancore, Kerala ; 2 Cuddapah, A.P. ; 2 Bastar, M.P. ; 1 Berbera, 1 Nayagarh State, Orissa ; 1 Tirhut, Bihar ; 1 Meerut, 2 Kanpur, 1 Bulandshahr, U.P. ; 1 Goalpara, 1 South Sylhet, Assam.

As indicated under the last species it is not possible to isolate any size or colour in this large series. The wings of two groups north and south of Bombay measure :

| | Males | Females |
|---|---|---|
| Bombay and southwards | (6) 182-204 av. 187 | (10) 187-214 av. 202 |
| Northern | (19) 173-216 av. 187 | (9) 191-219 av. 211 |

The seven males (4 north, 3 south) in adult plumage (grey above) have wings 174-186 av. 183.

The specimens from Assam and southern India agree with these rather than *poliopsis* (Burma) and nominate *badius* (Ceylon) respectively.

### 139. **Accipiter badius badius** (Gmelin) (Ceylon) 5 : 147

1 ♀ Anigalli, Ceylon, wing 202.

This differs from the other shikras from peninsular India in having the brown barring on the underparts as dark as in those from Burma. Two females in similar phases from Kumili, High Range, Kerala, and the Palnis are better grouped with *dussumieri* though a third from Jamestown, Kanyakumari District, is almost as dark as the Ceylon bird. A male from Edanad, Travancore, also agrees with *dussumieri*.

### 140 **Accipiter badius poliopsis** (Hume) (Northern Pegu) 5 : 151

7 : 2 ♂♂ 4 ♀♀ 1 o ?

1 *Pyawbe*, 1 *Seinban, Mandalay* ; 1 *Thani Chaung, Sandoway*, 1 *Ngaphaw, Prome* ; 1 *Toungoo*, 1 *Mindon, Thayetmyo* ; 1 (col. J. P. Cook 1913) ? *Burma*.

| Wing | ♂♂ | ♀♀ |
|---|---|---|
| 2 juveniles | 220 * | 204 * |
| 2 adults, brown above with grey heads | — | 216, 225 |
| 2 adults, all grey above | 203 | 196 * |

The three birds marked with an asterisk appear to be wrongly sexed. In the juveniles the tail has only four dark bands ; in the others the barring on the underparts is a deeper rufous and the sides of the head are concolorous with the crown instead of being tinged with brown or ashy as in the other races. As indicated under 138, the two specimens from Assam agree with *dussumieri* rather than this form.

### 141 **Accipiter badius butleri** (Gurney) (Car Nicobar) 5 : 151

nil.

142 **Accipiter badius obsoletus** (Richmond) (Katchal) ... **5** : 152

1 juv. ♂ Camorta, Central Nicobars. Wing 166 (192), tail 128 (157), 5th primary longest.

This specimen has more of a rufous wash both above and below than any other in similar plumage, and resembles a juvenile of *A. virgatus*. The irides were noted by the collector as orange-yellow though the type specimen had them crimson. The subspecific identification is based on the proximity of the type locality of this race.

143 **Accipiter soloensis** (Horsfield) (Java) Horsfield's Goshawk **5** : 153

nil.

The Andaman Islands are included in the range of this species (IND. HANDBOOK) but I have been unable to trace the evidence.

144 **Accipiter trivirgatus indicus** (Hodgson) (Nepal) Crested Goshawk **5** : 155

4 : 2 ♀♀ 2 o ?

1 Palkonda, 1 Lamasinghi, 1 Vizagapatam District ; 1 (col. C. M. Inglis) ? Bihar

| | | | | |
|---|---|---|---|---|
| 2 ♀♀ | wing 255, 267 | (238-267) | tail 202, 204. | |
| 2 o ? | 217, 222 | (♂ 224-237) | 172-179. | |

145 **Accipiter trivirgatus peninsulae** Koelz (Londa, N. Kanara)

10 : 6 ♂♂ 4 ♀♀ (1 ♀ pull.).

1 Anantgiri, Vizagapatam ; 1 Devonellikottah (?), 8 Palnis.

Though the sexes of this species are said to be similar in the FAUNA, Mayr (*Am. Mus. Novit.* 1415, 1949) states that including the juvenile (in which the sexes are similar) there are three distinct plumages. All the specimens do not appear to be correctly sexed but, accepting birds with dark grey heads contrasting sharply with the rest of the upper parts as males, the specimens measure :

| | Wing | | Tail | |
|---|---|---|---|---|
| 6 ♂♂ | 195-220 | av. 207 | 155-172 | av. 165 |
| 3 ♀♀ | 220-232 | av. 226 | 174-182 | av. 177 |

The male from Anantgiri was named *indicus* by Whistler (*JBNHS* **38** : 434) before *peninsulae* was described. It has a slightly paler and greyer head and a paler and more unbroken patch of earthy brown on the upper breast than the series from the Palnis but, as Mayr (loc. cit.) states that *indicus* is darker than *peninsulae*, I prefer to leave this here. A fresh series from the eastern Ghats around Vizagapatam would be of interest.

Incidentally, the northern limit of this race is North Kanara and not Khandesh, an error in the FAUNA which was corrected by Whistler (*JBNHS* **38** : 433) but was repeated in the SYNOPSIS and is now corrected in IND. HANDBOOK.

146 **Accipiter trivirgatus layardi** (Whistler & Kinnear) (Gillymally, Peak Forest, Ceylon)

nil.

EL **Accipiter nisus nisus**

4 ♀♀

3 *Iraq*, 1 *South Persia*.

Though this race is omitted from Indian literature, it may be worthwhile drawing attention to Vaurie (1965 : 168) who refers to its occurrence in Baluchistan. In series, they are darker than *nisosimilis* and measure :

| | | |
|---|---|---|
| Wing | 236-242 | av. 238.75 |
| Tail | 173-176 | av. 173.75. |

147 **Accipiter nisus nisosimilis** (Tickell) (Marcha, Borabhum) Sparrow-Hawk 5 : 156

19 : 10 ♂♂ 9 ♀♀ (5 imm. ♂♂).

1 *Amara*, 1 *Sulaimaniyah*, *Iraq* ; 1 *Shiraz* ; 2 Boya, 1 Chaman, Baluchistan ; 2 Chitral ; 1 Kutch ; 1 Cambay, 1 Rajpipla, 1 Surat Dangs, Gujerat ; 1 Belgaum, Mysore ; 1 Munchacholy Swamp (J. P. Cook 1891=South India ?) ; 2 Palni Hills, Madras ; 1 Meerut ; 2 *Peking*, *China*.

No. 22283 from the Palnis is very heavily frayed above and paler than *melaschistos*, though the 185 mm. tail suggests that race (q.v.).

148 **Accipiter nisus melaschistos** Hume [Interior of Himalayas. Restricted to Kotegarh (Simla Hills) N.W. Himalayas] 5 : 158

15 : 8 ♂♂ 7 ♀♀ (1 pull., 1 juv.)

12 Simla Hills ; 1 New Delhi ; 1 Wada, 1 Kalyan, Bombay.

When naming *nisosimilis*, Tickell (1833, *Journ. Asiat. Soc. Bengal* **2** : 571) mentioned no measurements and laid down the description of a single male obtained at Marcha, Borabhum. This form, however, is now accepted as slightly larger and paler than the European *nisus*. Hume's description of *melaschistos* is more exhaustive, but he compared his specimens with European birds, and made no reference to *nisosimilis*. His measurements of the wings and tails of the specimens examined by him exceed those determined by subsequent workers. An adult female is said to have a 221 mm. tail, while the largest available is 188 ; a young male wing is measured as 248 mm. against 216 in the largest and one can only assume that they were handled in a different manner.[1]

The type locality of *melaschistos* has been accepted in recent literature (IND. HANDBOOK/ and Vaurie's PALEARCTIC BIRDS 1965) as 'the

[1] After this went to the press, I received specimens from the Smithsonian Institution, said to be *melaschistos* including two females collected at Szechwan, China, Mopin-Tibetan border, and Tinjujre, E. Nepal, which are almost black above and have longer tails, 204 and 195 respectively. They appear appreciably different from all the others available in Bombay, and agree more closely with the original description. This matter will require further examination, as the series from the Simla Hills appears to be neither *melaschistos* nor *nisosimilis*. The subspecific grouping under serials 147 and 148 may, therefore, please be ignored. — H.A.

interior of the Himalayas'. In the first description (MY SCRAP BOOK ON INDIAN OOLOGY AND ORNITHOLOGY OR ROUGH NOTES, 1869 : 128) these words are used in a general manner but Hume specifically stated that the only two specimens which he obtained were near Simla. In the FAUNA (1929, 5 : 158) Stuart Baker refers to Hume's second note in *Ibis* for 1869 (which is not available to me) and gives the type locality as 'Kotegarh (Simla Hills—H.A.), N.W. India'. In spite of the fact that Hume (loc. cit. p. 124) refers to a Capt. Thompson assuring him that 'two pairs of the true Sparrow Hawk breed yearly in Anandale, just below Simla' it would be advisable, as supported by the facts detailed below to accept the restriction of the type locality of *melaschistos* to Kotegarh, Simla Hills.

The collection includes 10 birds (7 ♂♂ 3 ♀♀) from the Simla Hills and the adult males can be separated from the other (*nisosimilis*) males by their bright rufous under-parts in which the bars across the breast are 'fused' and scarcely visible. The upper-parts are much darker, almost slaty black.

The three races measure :

Males

| | Wing | | Tail |
|---|---|---|---|
| *nisus* | (BR. HANDBOOK 190-205) | | (BR. HANDBOOK 135-154) |
| *nisosimilis* | 197-213 | av. 203 (204-216) | 137-154 av. 146 (151-161) |
| *melaschistos* | 201-216 | av. 211 (212-219) | 145-172 av. 159 |

Females

| | Wing | | Tail |
|---|---|---|---|
| *nisus* | 236-242 | (BR. HANDBOOK 230-240) | 173-176 (BR. HANDBOOK 166-176) |
| *nisosimilis* | 227-248 | av. 240 (243-257) | 171-184 av. 175 (183-207) |
| *melaschistos* | 236-257 | av. 245 (245-260) | 180-188 av. 184 |

149 **Accipiter virgatus kashmiriensis** Whistler & Kinnear (Murree) Besra Sparrow-Hawk

5 : 4 ♂♂ 1 ♀ (2 ad. ♂♂, 1 ad. ♀, 2 juv. ♂♂).
3 Simla, 1 Ranikhet, 1 Koti State 7000′.

The two adult males are paler above than those of the next race.

Wing ♂♂ 164, 166 (IH 165-169) ; tails 124, 127 (IH 127·5-130).
Wing ♀ 201 (IH 196-207) ; tail 157 (IH 153-160).

150 **Accipiter virgatus affinis** Hodgson (Nepal) 5 : 161

2 ♂♂
1 Karuprayag, Garhwal ; 1 Nepal. Wings 162, 163 ; tails 125, 131.

151 **Accipiter virgatus besra** Jerdon (Soonda Jungles, south India) 5 : 159

6 : 2 ♂♂ 3 ♀♀ 1 o ?
1 Bhavnagar, Gujerat ; 1 Salsette, Bombay ; 3 Palni Hills, Madras ; 1 no data.

The two males have wings 150, 150 and tails 113, 114. The ♀ from Bhavnagar (wing 185, tail 142) which was recorded as *besra* agrees in

size with the adult female (by plumage) from the Palnis, but it is a juvenile and much paler in colour and appears to be of a northern race.

152 **Accipiter virgatus gularis** (Temminck & Schlegel) (Japan) Eastern Sparrow-Hawk **5** : 162

4 : 2 ♂♂ 2 ♀♀ (2 juvenile).

2 Middle Andamans, 1 South Andaman ; 1 Camorta, Central Nicobar.

The pair from Middle Andamans (wing ♂ 150, ♀ 187) in adult plumage have a broad mesial stripe (*contra* IND. HANDBOOK), while the other two in juvenile plumage (South Andaman ♂ wing 159 and Camorta ♀ 185) have a fine mesial stripe. This difference in the width of the gular stripe does not show in the other races.

153[1] **Buteo rufinus rufinus** (Cretzschmar) (Upper Nubia etc.) **5** : 137 Longlegged Buzzard

26 : 11 ♂♂ 7 ♀♀ 8 o ? 10 ad. with unbarred tails.
15 with brown tails, barred.
1 with brown unbarred tail.

1 *Amdia Barrage, Euphrates*, 1 *Sheik Saud, Mesopotamia*, 1 *Gumazgi*, 51 *miles west of Turbat*, 1 *South Persia*, 2 *Meirhum, Persian Gulf* ; 1 Quetta, 1 Miranshah, Kohat Dist., N.W.F.P., 1 Shali Peak, Bhajja State, 1 Keonthal State, N.W. Himalayas, 1 Kashmir, 1 Rawalpindi ; 1 Wazirabad, 1 Simla, 1 Bahawalpur Town, 1 Ambala, 1 Mooltan, Punjab ; 1 Delhi ; 1 Thar Parker, 1 Shah Hassan Manchar Lake, Sind ; 1 Tilwara, Jodhpur, 1 Kharagodha, 1 Bhavnagar, Kathiawar ; 1 Rajaputla, Chupriah ; 1 Sarun, Bengal ; 1 no data.

These specimens have all been listed under this species but without certainly identified material, it is not possible with the literature available to confirm or deny the identification. Apart from the differences in colour, the measurements of several specimens are either too large (5 ♂♂ Nos. 12588, 12598, 12600, 12603 and 12608. Wing 435-478 cf. ♂ 415-431 and ♀ 428-487 in FAUNA and Vaurie) or too small (2 ♂♂ Nos. 12594 and 12609, wing 390, 407, 2 ♀♀ Nos. 12605 and 19092, wing 405, 365).

154 **Buteo hemilasius** Temminck & Schlegel (Japan) Upland Buzzard **5** : 140

1 ♂ Tibet. Wing 477, tail 235 (Sp. No. 12613, Collected by F. M. Bailey and probably the basis of Kinnear's note, *JBNHS* **19** : 523). See also *JBNHS* **21** : 182 and NIDIFICATION **4** : 99.

This specimen was identified by Dr. Amadon.

155[1] **Buteo vulpinus vulpinus** (Gloger) (Africa) Desert Buzzard **5** : 142

4 : 2 ♂♂ 2 o ? (Nos. 12610, 12611, 12612, 19065).

1 *Bandar-e-Gaz, Astrabad, Caspian Province* ; 1 Simla ; 1 Abor Country, Mishmi Hills ; 1 col. by J.P. Cook in 1913=*Burma* (?) Wings 355, 370, 397, 430 ; tails 190, ——, 207, 216.

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[1] See footnote on p. 706 below.

156[1] **Buteo buteo burmanicus** Hume (Thayetmyo, Upper Pegu) Buzzard **5 : 143**

nil.

157 **Butastur teesa** (Franklin) (Ganga-Narbudda) White-eyed Buzzard-Eagle **5 : 104**

23 : 7 ♂♂ 14 ♀♀ 2 o? (3 imm. with streaked underparts including one with white head and no gular stripe).

1 *Qasrquand, Persian Baluchistan*; 1 *Khojdar, Persia*; 1 Rodkan, W. Kalwa, 1 Kilkaur, Baluchistan; 1 Jaswantpur, Rajputana; 1 Gir, 1 Patan, 1 Ajwa, 1 Cambay, 3 Bhavnagar; 2 Bombay, 3 Thana; 1 Raipur, Melghat, 1 Jabalpur; 2 Meerut, 1 Kanpur; 1 Narhar, Darbhanga, Bihar.

The measurements of wings and tails are slightly larger than in the FAUNA, with the birds from Madhya Pradesh and Uttar Pradesh appearing smaller than the others. There is no material from southern India for comparison :

| | Wing | Tail |
|---|---|---|
| 7 ♂♂ | 283-310 av. 297 (278-296) | 161-180 av. 171 (151-169) |
| 14 ♀♀ | 287-318 av. 297·5 (294-314) | 151-176 av. 159 |

An unsexed juvenile (No. 19621) from Bassein, Thana, Bombay, with a white head, measures wing 308 and tail 187.

The females' wings are about the same size as those of the males, but their tails and tarsi measure slightly less.

As most books indicate that this species does not extend beyond Baluchistan, it may be mentioned that it has been recorded as far west as Jask in the Gulf of Oman.

EL **Butastur liventer** (Temminck) (Java) Rufouswinged Buzzard-Eagle

2 ♀♀ : 1 *Oheme, Prome District*, 1 *Atran, Burma.* **5 : 106**

158 **Spizaetus nipalensis nipalensis** (Hodgson) (Nepal) Hodgson's Hawk-Eagle **5 : 89**

6 : 1 ♂ 2 ♀♀ 3 o? (2 adult ♀♀)

1 Wazirabad, Gujranwala, Punjab; 1 Marnavli 7600′, 1 Bhadrawah 9000′, 1 Kashmir; 2 *Chin Hills, Burma.*

The species is separated from *Spizaetus cirrhatus* and *limnaeetus* by the feathering on the tarsus extending on to the mid-toe.

The wings measure 424(o?)-480 (♀) (475-502 FAUNA. 440-480 adult ♂ & ♀ Amadon, *Ibis* 1953 : 496) and tails 275-310 (283-298).

[1] Some of these identifications may need revision—H.A.

159 **Spizaetus nipalensis kelaarti** Legge (Ceylon) Legge's Hawk-Eagle 5 : 91

1 ♂ Palni Hills, south India. Wing 412, tail 276.

Sálim Ali (BIRDS OF TRAVANCORE COCHIN, 1953, p. 302) refers to a male with a 402 mm. wing. Though treated with doubt by Amadon (loc. cit.) and synonymised by Vaurie (1965 : 181) with the nominate form, this is retained in IND. HANDBOOK. The little evidence available indicates a smaller bird in the south.

160 **Spizaetus (cirrhatus) limnaeetus** (Horsfield) (Java) Changeable Hawk-Eagle 5 : 87

3 : 2 ♂♂ 1 o ? (1 juv., all white below).
2 Darbhanga, Bihar ; 1 Jalpaiguri, Bengal.

This is distinguished from the next species by the absence of any crest. The upper parts are pale as in immature *cirrhatus*.

Wings 365, 392, 395 (400-438) Tails 246, 254, 260.

The smallest bird is in juvenile plumage. No specimen in the dark phase is available.

161 **Spizaetus cirrhatus cirrhatus** (Gmelin) (India) Crested Hawk-Eagle 5 : 85

15 : 6 ♂♂ 4 ♀♀ 5 o ? (5 juveniles).
1 Dediapada, 1 Juna, Rajpipla ; 1 Khandala, 2 Ratnagiri, 2 Karwar ; 1 Palkonda Hills, Cuddapah ; 1 Chatrapur, Ganjam, 1 Vizagapatam District ; 1 Sepaya Sevan, Bihar ; 1 Kheri, Oudh, 1 Gonda, 2 Dehra Dun.

The original reference is not available but according to Baker the nominate form *cirrhatus* with India as the type locality was described by Gmelin on page 274 of SYSTEMA NATURAE (1788), while *ceylanensis* from Ceylon was described on the following page.

In the SYNOPSIS (and the IND. HANDBOOK) the latter is not accepted as different, but the type locality for the nominate form is changed to Ceylon. I do not understand under what provision the change of type locality has been made. If Baker is correct in his statement that the description of *S. c. cirrhatus* preceded that of *S. c. ceylanensis*, I presume the former would take priority over the latter (which would at most be its junior synonym) and would retain its type locality.

Wing ♂♂ 383, 388, 397, 405, 420 (405-430 ; IH 351-442).
Tail ♂♂ 260, 261, 267, 283, 285 (280-290 ; IH 229-285).
Wing ♀♀ 415, 440 ; imm., 395, 432 (448-462 ; IH 353-462).
Tail ♀♀ 285, 292 ; imm. 269, 281 (IH 266-300).

161a **Spizaetus cirrhatus ceylanensis** (Gmelin) (Ceylon) 5 : 86

1 ♂ adult, Ceylon. Wing 351 (353-383) ; tail 223 (227-260).

This race was described for its smaller size, and the single specimen supports Amadon (*Ibis* 1963 p. 493). The white border to the crest is more prominent than in other specimens.

162 **Spizaetus cirrhatus andamanensis** Tytler (Port Blair, South Andaman Island) **5** : 88

nil.

163 **Hieraaetus fasciatus fasciatus** (Vieillot) (Montpellier, France) Bonelli's Hawk-Eagle **5** : 77

7 : 4 ♂♂ 2 ♀♀ 1 o ?

1 Ormara, Baluchistan ; 1 Bahawalpur ; 1 Fatehpur, Rajasthan ; 1 Mehsana, 1 Baroda ; 1 Akalkot, Sholapur ; 1 Baghowni, Darbhanga, Bihar.

The specimens available measure slightly less than indicated in the FAUNA, and are corrected in IND. HANDBOOK.

| | Wing | Tail |
|---|---|---|
| 4 ♂♂ | 453-495 av. 468 (IH 458-520) | 243-260 av. 252 (IH 246-266) |
| 2 ♀♀ | 470, 495 (IH 490-550) | 255 (IH 254-285) |

However, the key on page 265 of IND. HANDBOOK is copied from the FAUNA and still shows a minimum wing of 480.

The streaking on the underparts varies appreciably and one male and a female are much darker below. Both this and the next species can be separated from *Spizaetus*, by the primaries exceeding the secondaries by more than the length of the tarsus.

As the occurrence of this species in Assam and East Pakistan is queried (IND. HANDBOOK 1 : 266) it may be mentioned that Woods, in SHIKAR MEMORIES (1934) p. 30, gives its Manipuri name as *Koruk-Cowbee* and states that it takes winged duck.

164 **Hieraaetus pennatus** (Gmelin) (No type locality given) Booted Hawk-Eagle **5** : 79

12 : 7 ♂♂ 5 ♀♀ (6 adult, 6 juv.).

1 Chitral, N.W.F.P., 1 Jammu, Kashmir ; 1 Simla ; 1 Patan, Mehsana ; 2 Bombay, 1 Thana, 1 Ratnagiri ; 1 North Kanara ; 1 Benares ; 1 Bihar ; 1 Bhutan Duars.

The birds in adult and juvenile plumage do not differ in size and measure :

| | Wing | Tail |
|---|---|---|
| 7 ♂♂ | 375-390 av. 380 (370-412) | 189-205 av. 198 (188-192) |
| 5 ♀♀ | 370-415 av. 391 (IH 385-423) | 190-220 av. 204 (IH 204-225) |

All the specimens from peninsular India have been obtained between November and March, and presumably represent non-breeding migrants.

165 **Lophotriorchis kienerii kienerii** (E. Geoffroy) (Himalayas) Rufous-bellied Hawk-Eagle **5** : 80

3 : 1 ♂ 1 ♀ 1 o ? (1 ♂ juvenile).

1 Anaimalai Hills, Travancore ; 1 Coonoor ; 1 Yellambellary, south India.

Wing ♂ juv. 384, ♀ 398, o ? 372 (♂ about 380, ♀ 405-433).

Tail ♀ juv. 185, ♀ 207, o ? 202 (♂ about 204, ♀ 228-242).

The measurements of these southern birds are a little smaller than those indicated in the FAUNA which are reproduced in IND. HANDBOOK (**1** : 272).

166 **Aquila chrysaetos daphanea** Severtzov (Russian Turkestan, Mongolia, Himalayas, etc.) Golden Eagle **5** : 68

6 : 3 ♂♂ 1 ♀ 2 o ? (3 imm.* with white in tails).

1 Quetta, Baluchistan ; 2 Chitral, N.W.F.P. ; 1 Kishinjunga Valley, Kashmir ; 1 Simla, 1 Wazirabad, Punjab.

The measurements differ from those in the FAUNA and IND. HANDBOOK.

| | 3 ♂♂ | 1 ♀ | 2 o? |
|---|---|---|---|
| Wing | 610*, 622*, 660 (630-655) | 617 (660-700) | 615*, 670 |
| Tail | 311*, 324, 360* (315-335) | 328 (350-365) | 333*, 380 |
| Tarsus | 117, 117, 118 (89-95) | 118 (95-105) | — — |

167 **Aquila heliaca heliaca** Savigny (Upper Egypt) Imperial Eagle **5** : 69

12 : 4 ♂♂ 6 ♀♀ 2 o ? (4 juv. streaked below).

1 *Belad, Tigris* ; 1 *Fateamah, Persia* ; 1 Lahore, 1 Wazirabad, 1 Hoshiarpur ; 2 Pithora, 1 Sind ; 1 Little Rann of Kutch ; 1 Bhavnagar ; 1 Goona, C.I. ; 1 Kurseong, Darjeeling.

The tail is barred in adults, and unbarred in juveniles. Before the buff nape patch is acquired, the all-brown bird is difficult to separate from *nipalensis*, for the measurements are not as distinctive as indicated in most literature and overlap to a great extent.

| | ♂ | ♀ |
|---|---|---|
| | Wing | |
| *heliaca* | 542, 565, 570, 570 (575-600) | 575-620 av. 603 (605-630) |
| *nipalensis* | 560, 570, 580 (510-595) | 550 (602-625) |
| | Tail | |
| *heliaca* | 262, 265, 274, 276 (253-270) | 263-289 av. 280 (253-270) |
| *nipalensis* | 265, 282, 289 (250-290) | 252 (250-290) |
| | Tarsus | |
| *heliaca* | 95, 100, 100, 104 (91-95) | 100-107 av. 104 (91-95) |
| *nipalensis* | 90, 90, 93, 98 (85-89) | 83, unsexed 99, 103 |

168 **Aquila rapax vindhiana** Franklin (Vindhya Hills, Central India) Tawny Eagle **5** : 72

30 : 11 ♂♂ 15 ♀♀ 4 o ?

1 Gidar, 1 Hazariganj, Kalat, Baluchistan ; 3 Hyderabad, Sind ; 1 Lahore, 1 Ambala, 4 Wazirabad, Punjab ; 1 Fatehpur, U.P. ; 2 Godwara, 1 Jodhpur, Rajasthan ; 1 Kutch ; 3 Palanpur, 1 Mehsana, 1 Dabka, 1 Cambay, 1 Rajpipla, Gujerat ; 2 Greater Bombay, 1 Lonavla, 3 Panchgani, Maharashtra ; 1 Gwalior, Madhya Pradesh.

As is well known, the birds show great differences in plumage. The present specimens can be divided roughly into two groups, pale (13) and dark (16). They measure :

| *Pale* | *Dark* |
|---|---|
| ♂♂ Wing | |
| (IH 500-535 ; *Vaurie* 490-540 av. 520) | |
| 480-539 av. 505 | 475-498 av. 488 |
| ♂♂ Tail (IH 242-258) | |
| 230-247 av. 241·6 | 221-246 av. 233 |

♀♀ Wing
(IH 510-560 ; *Vaurie* 510-550 av. 530)

| | |
|---|---|
| 500-533 av. 515 | 508-530 av. 520 |

♀♀ Tail (IH 242-285)

| | |
|---|---|
| 236-250 av. 242·5 | 234-262 av. 248 |

Though the number available is admittedly small, it is curious that the pale males, which represent a juvenile plumage as per Vaurie p. 184 (*contra* FAUNA loc. cit.), have slightly larger wings and tails than the dark (adult) males. The dark females average larger and in series are darker than the adult males.

Of the 4 specimens with unbarred tails, only one is in adult plumage (dark), while of the 7 with distinct caps of brown or rufous, 6 are pale, suggesting that the barred tail and the concolorous head and back are adult characters.

EL **Aquila rapax orientalis** Cabanis (near Sarepta, SE. Russia).

2 o ? : 1 *Basra*, 1 *Kut, Mesopotamia.*

Both have large oval nostrils and measure :

| | | | | |
|---|---|---|---|---|
| No. 12303 Basra | Wing 520 | Tail 291 | Tarsus 94 |
| 12306 Kut | 538 | 260 | 83 |

Both were named *Aquila rapax albicans* Rupp. (Type locality Simen Province in Abyssinia) by Sclater (*JBNHS* **28** : 421) which race is not now accepted. No. 12306 has been identified as *orientalis* by Mr. Bond and I am leaving both under this name.

169 **Aquila nipalensis nipalensis** (Hodgson) (Nepal) Steppe Eagle. **5** : 70

8 : 4 ♂♂ 2 ♀♀ 2 o ? (1 head only).

1 *Sera, Tigris* ; 1 Hissar, 1 Wazirabad, 1 Dharamsala Cantt. ; 1 Pung Bet*, Little Rann, Kutch ; 1 Gwalior ; 1 Gonda, U.P. ; 1 no data.

Several specimens have very distinct buffish wing bars, which is an immature character (BR. HANDBOOK **3** : 43), lacking in *heliaca*. The measurements of the specimens are compared to those of *heliaca* above, and shown to overlap to a great extent.

♂ Specimen No. 12290 (Little Rann of Kutch) has its breast streaked with buff and is very similar to the juvenile of *heliaca* [wing 550 (570 fresh), tail 276, tarsus 92]. It was obtained on the same day as an undoubted *heliaca*, but I am leaving it under this species, as it has been so identified by Sálim Ali and Meinertzhagen.

170 **Aquila clanga** Pallas (Russia and Siberia) Greater Spotted Eagle **5** : 74

9 : 6 ♀♀, 3 o ? (3 spotted juvenile).

1 *Baghdad* ; 1 Ormara, Las Belas, Baluchistan ; 1 Gujranwala, Punjab ; 1 Bharatpur, Rajasthan ; 1 Kaira, Gujerat ; 2 Lake Beale, Nasik, Maharashtra ; 2 Rajputtee Chupra (Saran), Bihar.

6 ♀♀ Wing 500-540 (FAUNA 542-565, BR. HANDBOOK 500-550); tail 230-272 (240-260); tarsus 97-106 (103-106).

In IND. HANDBOOK, the measurements of four Indian females are given as: wing 514-545; tail 242-272.

This and the next species can be separated from the other *Aquila* by their round (and not elongated or ear-shaped) nostrils. The two from Rajputtee Chupra have ' roundish ' nostrils and have been identified by C. H. Donald. Others listed as *A. nipalensis rapax* are very similar. It is also difficult to separate this species from *hastata* except by size—this is generally larger, but the wing and tail measurements are said to overlap. In the absence of any other character, I have for the moment transferred a spotted bird from Ormara to *clanga* leaving the sexed specimens in both species, curiously all females (there is no sexed male of either species!), in two distinct size groups.

171 **Aquila pomarina hastata** (Lesson) (Bengal) Lesser Spotted Eagle **5**: 75

5 : 3 ♀♀ 2 o ?, heads only*

1 Gonda*, 1 Gorakhpur*, U.P.; 1 Tirhut, 1 Binburn, Bihar (?); 1 Kalyan, Thana, Maharashtra.

1 ♀ from Tirhut is a fledgling with pale longitudinal specks on the head, *contra* IH **1**: 283.

2 ♀♀ wing 470, 475 (493-508); tail 208, 234 (230-248); tarsus 93, 93 (100-104).

172 **Ictinaetus malayensis perniger** (Hodgson) (Nepal) Black Eagle **5**: 83

4 : 2 ♂♂ 2 o ?

2 Darjeeling, Bengal; 1 Nilgiris, Madras; 1 Wynaad, Kerala.

The four specimens do not vary appreciably in the size of their wing (550-570) and tail (294-309) but two (1 o ? Wynaad, 1 ♂ Darjeeling) have their bill smaller (27 mm. from cere) than the other two—(30 mm. 1 ♂ Darjeeling, 1 o ? Nilgiris).

In IND. HANDBOOK (**1**: 284) it is implied that north of Goa along the Western Ghats only sight records exist, from Bombay and Jambughoda in Gujerat. While there can be no doubt that some of these records are good, it may be worthwhile drawing attention to a specimen which was shot at Virar, a little north of Bombay, the head and legs of which were identified at the Society (*JBNHS* **41**: 899).

172a **Haliaeetus albicilla** (Linnaeus) (Sweden) Whitetailed Sea Eagle **5**: 110

nil.

This species is a winter visitor to our area extending to the Punjab, North West Provinces (Uttar Pradesh), and Sind. It was omitted in the SYNOPSIS but is included in IND. HANDBOOK where it is spoken of as a casual winter visitor to West Pakistan (Baluchistan, Sind, NWF. Province) and of which there is only one reliable record from India (Kulu, Donald).

173 **Haliaeetus leucogaster** (Gmelin) (Prince's Island, Indonesia) Whitebellied Sea Eagle 5 : 111

3 : 1 ♂ 2 o ? (1 juv.*).

1 Chatrapore, Ganjam, A.P. ; 1* Port Blair, Andamans ; 1 Campbell Bay, Great Nicobar.

174 **Haliaeetus leucoryphus** (Pallas) (Lower Ural River) Pallas's Fishing Eagle 5 : 112

9 : 7 ♂♂ 2 o ? 3 in adult plumage.

1 Kashmir ; 1 Wazirabad, 1 Bahawalpur, Punjab ; 1 Saran, 1 Tirhut, 1 Baghowni, 1 Lowa Chupra, Bihar ; 1 Kurseong, Bengal ; 1 no data.

175 **Icthyophaga ichthyaetus ichthyaetus** (Horsfield) (Java) Greyheaded Fishing Eagle 5 : 114

4 : 2 ♀♀ 2 o ?

1 Kissenganga (Kashmir ?) ; 1 Melghat, Berar ; 1 Narhora, Madhubani, 1 Nawada Lake, Champaran, Bihar.

No. 1247, a ♀ fledgling taken at Narhora, Madhubani, by C. M. Inglis, has the feathers of the head heavily marked with short streaks of buff, a pale buff chin, and brown under-parts streaked with buff.

176 **Icthyophaga ichthyaetus plumbeiceps** Baker (Trincomalee, Ceylon) Ceylon Greyheaded Fishing Eagle 5 : 116

nil.

177 **Icthyophaga nana plumbea** (Jerdon) (Northwestern Himalayas) Himalayan Greyheaded Fishing Eagle 5 : 117

1 ♂ Balasun 2000′, near Darjeeling, Bengal.

178 **Torgos calvus** (Scopoli) (Pondicherry) Black Vulture 5 : 9

1 o ? Gazipur, U.P.

179 **Aegypius monachus** (Linnaeus) (Arabia) Cinereous Vulture 5 : 7

1 o ? Hoshiarpur, Punjab.

180 **Gyps fulvus fulvescens** Hume (Gurgaon, Punjab) Griffon Vulture 5 : 11

1 o ? Kurla, Bombay. (February 1893).

This specimen, evidently a straggler, is the southern-most record of this species.

181 **Gyps himalayensis** Hume (Himalayas from Kabul to Bhutan) Himalayan Griffon Vulture 5 : 13

nil.

182 **Gyps indicus indicus** (Scopoli) (India) Indian Longbilled Vulture **5** : 16

3 : 1 o ? 2 nestlings.
1 nestling, Karnala, Panvel, Kolaba Dt. ; 2 ?

The young in the nest are in colour similar to the adults which can be separated from immature *bengalensis* (yet without white backs or under-wings) by the longer cere.

183 **Gyps indicus jonesi** Whistler (Margala Range, Rawalpindi Dist.) **5** : 18
nil.

184 **Gyps indicus tenuirostris** G. R. Gray (Kahtmandu, Nepal) **5** : 17
nil.

185 **Gyps bengalensis** (Gmelin) (Bengal) Whitebacked Vulture **5** : 19

8 : 4 ♂♂ 3 ♀♀ 1 o ? (1 nestling).
6 Bombay & Salsette, 1 Panvel, Kolaba Dist. ; 1 Gazipur, U.P.

The nestling is almost as dark as the adult, but with no white on the rump or under-wings. The breast is prominently streaked with white. Nos. 12092 and 22697 were listed as *G. indicus*, but they are very similar to others in the brown, sub-adult plumage of this species, in which I have seen it breeding. The number of tail feathers is not 14, but this character does not show even in the adult *bengalensis* available, and I am for the moment treating them as of this species on the basis of their shorter ceres.

186 **Neophron percnopterus percnopterus** (Linnaeus) (Egypt) Egyptian or Scavenger Vulture **5** : 22

187 **Neophron percnopterus ginginianus** (Latham) (Gingee, Coromandel) **5** : 23

4 : 1 ♂ 2 ♀♀ 1 o ? (1* immature ♀).
1 north of Ornach, Baluchistan ; 1 Datta Kehl, N.W.F.P. ; 1 Lolab Valley, Kashmir ; 1 Simla*.
Wings ♂ 455 ♀♀ 455, 460 o ? 485 (474-506 ; *ginginianus* 443-482).
Tail 235, 235, 220, 230 (205-263 ; *ginginianus* 228-251).
Culmen 58, 62, 59, 66 (58-65 ; *ginginianus* 72-85 ?).

According to the distribution usually accepted, these birds should all be of the typical race, but the measurements are closer to those of *ginginianus* and the bills in all the adults are bright yellow. Whistler (*Ibis* 1922 : 414) and Paludin ON THE BIRDS OF AFGHANISTAN (1959 :77) have referred to these incongruities regarding size (Punjab) and colour but in the absence of any material from further south, it is not possible to determine to what race or races these specimens belong. IND. HANDBOOK (**1** : 311) suggests the possibility of both races occurring together and interbreeding over marginal areas.

188 **Gypaetus barbatus aureus** (Hablizl) (Province of Gilan, northern Persia) Bearded Vulture or Lämmergeier **5 : 26**

13 : 4 ♂♂ 1 ♀ 8 o ? (2, heads only) (6 ad. 5 juv.).

1 Quetta ( ? Museum) ; 2 Chitral ; 2 Bhadarwar, Kashmir ; 3 Simla Hills, 1 Eastern Himalayas ; 4 no data (2, heads only).

The three males in adult plumage measure :

Wing 777, 805, 820 ; tail 470, 542, 493 ; tarsus 93, 93, 104.

189 **Circus cyaneus cyaneus** (Linnaeus) (Vicinity of London, England) Hen-Harrier **5 : 131**

11 : 5 ♂♂ 4 ♀♀ 2 o ? (3 ad. ♂♂ 1 ad. ♀).

1 *Astrabad, Caspian Province* ; 1 *Bampur, Persian Baluchistan* ; 1 *Murghab, Herat, Afghanistan* ; 1 *Gyantse, Tibet* ; 1 Datta Kehl, Waziristan ; 1 Gilgit, Kashmir ; 1 Simla, 1 Patiala ; 3 *Peking, China.*

The notch in the outer web of the 5th primary separates this from *macrourus* and *pygargus.* Thirteen specimens were wrongly listed under these three species.

| | | | | |
|---|---|---|---|---|
| Wing | ad. ♂♂ | 337, 341, 347 | ad. ♀ | 388 |
| Tail | | 211, 218, 220 | | 244 |
| Tarsus | | 67, 69, 69 | | 75 |

190 **Circus macrourus** (S. G. Gmelin) (Voronezh, Southern Russia) Pale Harrier **5 : 128**

34 : 20 ♂♂ 11 ♀♀ 3 o ? (juv. 5 ♂♂, 4 ♀♀).

3 *Randa Tanhat, Yemen* ; 1 *Sulaimaniya*, 4 *Mesopotamia* ; 2 *Shiraz* ; 1 Chitral ; 1 Boya, N. Waziristan ; 1 Wazirabad, 1 Jagadhiri, Punjab ; 1 near Manchar Lake, Sind ; 1 Delhi ; 1 Sunda Hills, Jaswantipura Dist., Rajputana ; 3 Cutch ; 1 Dohad, 1 Nadiad ; 1 Pasola, E. Khandesh, 1 Nasik, 2 Bombay, 2 Thana, 2 Jeypore, Vizagapatnam ; 1 Meerut ; 1 Baghowni, Tirhut ; 1 Calcutta Market ; 1 no data.

| | Wing | Tail | Tarsus |
|---|---|---|---|
| 15 ad. ♂♂ | 327-350 av. 338 (332-360) | 197-213 av. 204 (201-221) | 62-73 av. 65 (66-70) |

These include 8 birds in which the heads are yet brown and not grey.

| | Wing | Tail | Tarsus |
|---|---|---|---|
| 5 juv. ♂♂ | 322-334 av. 330 | 200-213 av. 209 | 65-70 av. 68·5 |
| 7 ad. ♀♀ | 362-381 av. 371 (IH 345-386) | 226-241 av. 233 (IH 229-247) | 65-75 av. 71 (67-78) |
| 4 juv. ♀♀ | 352-370 av. 363 | 220-244 av. 232 | 71-75 |

The Pale and Montagu's Harriers differ from the other three species in lacking the notch on the outer web of the 5th primary. In this species the coverts normally conceal the notch in the outer web of the 2nd primary, which remains exposed in Montagu's. If the coverts are not fully grown (?), the longer tarsus is distinctive.

191 **Circus pygargus** (Linnaeus) (England) Montagu's Harrier **5 : 130**

8 : 5 ♂♂ 3 ♀♀ (2 adult ♂♂).

1 *Murghab, Herat* ; 1 Kronthal State ; 1 Belapur, Ahmednagar, 2 Nasik, 1 Talegaon Poona, 1 Andheri, Bombay ; 1 Jubbulpore, M.P.

♂♂ Wings ad. 355, 385 ; juv. 334, 348, 356 (344-395).

♀♀ 357, 367, 369 (344-395).
♂♂ Tails ad. 210, 222 ; juv. 205, 208, 209 (213-241).
♀♀ 215, 216, 227.
♂♂ Tarsus ad. 57, 58, juv. 55, 56, 57 (55-65)
♀♀ 57, 58, 61.

This species can be separated from *macrourus* by the primary coverts falling short of the notch in the outer web of the 2nd primary, and by the shorter tarsus.

192 **Circus melanoleucos** (Pennant) (Ceylon) Pied Harrier 5 : 132

8 : 7 ♂♂ (2 by plumage) 1 ♀* (missing).

1 Rajputee Chupra, 1 Baghowni, Tirhut, 1 Narhar, Madhubani ; 1 *Upper Burma*, 3* *Prome District* ; 1 no locality (collected by F.J.R. Field=U.P. ?).

♂♂ Wings 345-363 av. 353 (344-367).
♂♂ Tails 196-218 av. 206 (197-217).
♂♂ Tarsus 71-75 av. 73 (76-80).

As in *C. cyaneus* the 5th primary is indented on the outer web. Two *C. cyaneus* in female plumage were listed under this species which has a larger tarsus.

193 **Circus aeruginosus aeruginosus** (Linnaeus) (Sweden) Marsh Harrier 5 : 134

27 : 17 ♂♂ (1 by plumage) 6 ♀♀ 4 o ? (10 ad. ♂♂ with grey wings and tail, 6 sub-ad. with pale heads, 1 juv. all brown, with pale nape).

1 *Amara*, 2 *Lake Akkarkuf*, 1 *Basra*, *Iraq* ; 1 *Magos*, 1 *Gumazzi*, 51 *miles west of Turbat*, 1 *Kaftarok*, 11 *miles east of Shiraz*, *Iran* ; 1 Chitral, 1 Wana, S. Waziristan ; 1 Shah Hassan, Manchar Lake, 1 Sufi Talao, Pithora, 1 Dadin Larkana, Sind ; 1 Cutch ; 1 Gwalior ; 1 Bassein, 1 Karanja Is., Bombay ; 2 Kanara, 1 Mysore ; 1 Gondia, C.P. ; 2 Baghowni, 1 Saran, Bihar ; 2 *Prome*, 1 *Henzada*, *Burma* ; 1 no data.

Wing
♂♂
10 ad. 364-399 av. 384 (385-405 ; BR. HANDBOOK 375-415) 6 sub-ad. 379-415 av. 393.
♀♀
4 ad. 395-422 av. 407 (390-430 ; BR. HANDBOOK 390-420)
2 juv. 418, 423

Tail
♂♂
10 ad. 210-227 av. 216 (234-245 ; BR. HANDBOOK 210-230) 6 sub-ad. 213-231 av. 222.
♀♀
4 ad. 219-255 av. 231·5 (238-258)
2 juv. 233, 240

Tarsus
♂♂ 10 ad. 76-84 av. 81·5 (80-85) 6 sub-ad. 80-87 av. 83.
♀♀ 4 ad. 81-87 av. 84 (85-90) 2 juv. 84, 86.

The males average a little smaller than the females, but it is curious that the sub-adults, with pale caps similar to the females, are larger than

the adults. This is possibly due to incorrect sexing. One specimen with a grey tail was marked female but has been measured with the males. There is great variation in the tone of brown but I am unable to separate any as *spilonotus*.

194 **Circus aeruginosus spilonotus** Kaup (Asia) **5** : 135
nil.

195 **Circaetus gallicus gallicus** (Gmelin) (Astrakan, South Russia) Short-toed Eagle **5** : 93

15 : 7 ♂♂ 6 ♀♀ 2 o ? (3 juveniles).

1 Wazirabad, 1 Madhopur, Punjab ; 1 Kuno, Gwalior ; 1 Deesa, 2 Baroda, 1 Daman ; 1 Ghoti, Nasik, 3 Thana, 1 Bombay ; 1 Ootacamund ; 1 Fatehpur, U.P. ; 1 no data.

| | | | | | |
|---|---|---|---|---|---|
| Wing ♂♂ | 510-533 av. 520 | (520-536) | ♀♀ | 508-554 | av. 536 (530-571) |
| Tail | 248-284 av. 277 | (252-288) | | 268-295 | av. 270 (287-330) |
| Tarsus | 83-94 av. 89 | (92-97) | | 87-101 | av. 93 |

In this small series, the barring on the underparts appears more prominent in the females than in the males. The three juveniles show white on the head and are on the upperparts slightly paler than the others, though they agree with them in their measurements.

Two males are pure white below except for fine shaft streaks on the chin and upper breast.

196 **Spilornis cheela cheela** (Latham) (Lucknow) Crested Serpent Eagle **5** : 96

13 : 6 ♂♂ 5 ♀♀ 2 o ? ( 1 juvenile ♀).

1 Patiala, Punjab ; 1 Bhavnagar ; 1 Malwa, C.I. ; 1 Hoshangabad, M.P. ; 1 Baghowni, Darbhanga, Bihar ; 1 Dehra Dun, 2 Salukapur, 1 Almora ; 1 Nepal ; 1 Kurseong, Bengal ; 2 Assam.

The nominate race can be differentiated from southern *melanotis* by the barring on the upper breast, the black chin, and the almost-white pale bar on the tail. This type occasionally occurs in the normal range of *melanotis* and represents either an individual variation or a non-breeding migrant. Nos. 12406 from Bhavnagar and 22376 from Hoshangabad, both males are two such instances, which have been noted as far south as Mysore (*JBNHS* **44** : 21).

On the whole the males appear to have their underparts paler than the females and are also slightly smaller.

| Wing | Tail | Tarsus |
|---|---|---|
| 6 ♂♂ 445-500 av. 476 | 255-309 av. 287 | 96-113 av. 104 |
| 4 ♀♀ 458-505 av. 477 | 266-315 av. 291 | 102-110 av. 106 |
| ♂♀ (468-507) | (295-315) | (100-102) |

This race is slightly larger than the southern *melanotis*.

197 **Spilornis cheela melanotis** (Jerdon) (At the foot of the Nilgiris) **5** : 98

15 : 5 ♂♂ 6 ♀♀ 4 o ? (2 ♂♂, 2 ♀♀ juveniles).
1 Palanpur, 2 Gir ; 2 Ratnagiri ; 2 North Kanara ; 1 south India ; 1 Tenmalai, Travancore ; 2 Vizagapatam ; 1 Bastar, M.P. ; 1 Badrawa, 1 Berbera, 1 Chilka.

The brown upper breast and the grey band on the tail separate this from the northern race. The black chin is also absent.

The adults measure :

| | Wing | Tail | Tarsus |
|---|---|---|---|
| ♂♂ | 415, 419, 439 | 255, 258, 275 | 95, 100, 108 |
| ♀♀ | 425, 431, 457, 465 | 264, 274, 275, 302 | 95, 99, 102, 107 |

198 **Spilornis cheela spilogaster** (Blyth) (Ceylon) **5** : 100

nil.

199 **Spilornis cheela burmanicus** Swann (Jobin, Thayetmyo, Burma) **5** : 99

2 : 1 ♂ 1 ♀

| | Wing | Tail | Tarsus |
|---|---|---|---|
| ♂ *Tonokmaw, Prome* | 447 | 260 | 98 |
| ♀ *Akyab* | 472 | 283 | 102 |

These two specimens could well be included with the nominate form which they resemble in the barring on the lower parts, the pale patch on the tail, and the dark chin (Akyab).

200 **Spilornis elgini** (Blyth) (South Andaman Island) Andaman Serpent Eagle **5** : 103

1 ♀ Mannarghat, South Andamans.
Wing 380 tail 218 tarsus 80.

As indicated in my Andaman paper (*JBNHS* **61** : 509), this appears to be very distinct from the paler Serpent Eagle *davisoni* which occurs in the same area, and must be placed in a separate species.

200a **Spilornis cheela davisoni** Hume (Neighbourhood of Port Blair) **5** : 103

2 ♀♀ : 1 Bakultala, Middle Andamans, 1 Pochang, South Andamans.
Wing 393, 393 ; tail 235, 245 ; tarsus 80, 82.

But for its smaller size, this form appears to be very similar to *melanotis*. In IND. HANDBOOK it is synonymised with *elgini*.

201 **Spilornis cheela minimus** Hume (Camorta, Nicobar Islands) **5** : 102

nil.

202 **Spilornis cheela klossi** Richmond (Pulo Kunyi, Great Nicobar Island) **5** : **102**

nil.

203 **Pandion haliaetus haliaetus** (Linnaeus) (Sweden) Osprey **5** : 3

9 : 5 ♂♂ 4 ♀♀

1 *Shaiba, Arabia* ; 1 *Tanb Island, Persian Gulf* ; 1 Cashmere* ; 1 Bahawalpur State ; 1 Chilka Lake, Orissa ; 1 Madhubani, 1 Tirhut, Bihar ; 1 Dehra Dun ; 1 no data.

| | Wing | Tail | Tarsus |
|---|---|---|---|
| 5 ♂♂ | 460-490 av. 474 (452-495) | 187-215 av. 201 (191-223) | 59-61 av. 60 (59-65) |
| 4 ♀♀ | 470-491 av. 481 (468-508) | 205-215 av. 210 (204-220) | 58-65 av. 62 |

IND. HANDBOOK adds the following measurements :—

| | | | |
|---|---|---|---|
| 2 ♂♂ | 481-481 | 201-210 | — |
| 3 ♀♀ | 482-537 | 200-251 | 60-61 |

* Only one specimen (No. 12082) has a complete brown band across the breast.

204 **Microhierax caerulescens caerulescens** (Linnaeus) (Asia = Bengal) Redthighed Falconet **5** : 52

8 : 1 ♂ 4 ♀♀ *3 o ? juveniles.

1 Nepal ; 3 Darjeeling, Bengal ; *4 Assam.

The male measures—wing 100, tail 59 and the females—105-114 av. 110·5 and 57-67 av. 61. The 3 juveniles, which are not dated, were probably collected at the same time by C. M. Inglis. The breast is whitish, but not quite white as the Burmese race.

Ripley has changed the long-standing English name of Redlegged to Redbreasted. The first name was misleading for it is the thighs, and not the legs, that are so coloured. I think it would be best to associate the distinctive term with that part which varies in colour in the different species, as has been done by Smythies in THE BIRDS OF BURMA.

EL **Microhierax caerulescens burmanicus** Kirke-Swann (Thayetmyo) Burmese Redthighed Falconet **5** : 53

3 : 1 ♀ 2 o ?

1 *Kungulthana* ; 1 *Mt. Victoria* ; 1 *Taunggyi, S. Shan States.*

The white breast and smaller size, wing : 94, 96, 101 (tails 55, 55, 61) distinguish them from Indian birds. The one bird marked as a female has the smallest wing and may have been wrongly sexed.

205 **Microhierax melanoleucos** (Blyth) (Assam) Whitethighed Falconet **5** : 54

2 : 1* ♂ 1 o ?

1 Haflong, Cachar, 1* Margherita, Lakhimpur, Assam.

The measurements of the male are not included in the FAUNA, and the single specimen appears to be slightly smaller than the females :

Wing 108 (111-117), tail 66 (71-73), tarsus 20 (22).

As my measurements differed from those of the same specimen in IND. HANDBOOK, I have rechecked mine.

206 **Falco biarmicus cherrug** J. E. Gray (India) Saker or Cherrug Falcon **5** : 39

3 : 2 ♂♂ 1 ♀

1 *Baghdad, Iraq* ; 1 *Ahwaz, Iran* ; 1 Waynabad, Kashmir.

2 ♂♂ Wing 334, 365 (348-370) ; tail 186, 195 (190-200)

1 ♀ Wing 410 (390-412) ; tail 222 (207-210).

207 **Falco biarmicus milvipes** Jerdon (Umballa, India) Shanghar Fálcon **5** : 41

2 : 1 ♀ 1 o?
1 *Kashgar, China* ; 1 Ladakh, Kashmir.
Wing 334 ♀, 363 (♂♂ 340-351, ♀♀ 374-435)
Tail 186 ♀, 190 (188-236)

208 **Falco biarmicus jugger** J. E. Gray (India) Laggar Falcon 5 : **37**

18 : 7 ♂♂ (2 by size) 11 ♀♀ (1 by size)
(1 * ♀ pullet, 2 ♂♂ 6 ♀♀ juveniles)

1 Dandar, W. Kolwa, 1 Chuttok, 95 miles south of Kalat, Baluchistan ; 2 Bhong, Bahawalpur, 1 Jhelum, Punjab ; 1* Bela Island, Kutch, 1 Deesa, Palanpur, 1 Dabka, Baroda ; 1 Jaswantpura, Rajputana ; 1 Mandu, Dhar State, C.I. ; 2 Mira Road, Salsette, 1 Wada, Thana, 1 Bombay ; 2 Tirhut, 1 Rajputee Chuprah, Bihar ; 1 Fatehpur, U.P.

IND. HANDBOOK has this as a race of *F. biarmicus* but Vaurie (1965) leaves it as a separate species as has been customary.

In this series the males and females fall into two size groups in which there is no overlap in the size of the wings. Three unsexed birds are placed according to their size. The adults are no larger than the juveniles and their measurements are grouped together :

| | Wing | Tail | Mid-toe without claw |
|---|---|---|---|
| 7 ♂♂ | 313-326 av. 319 (305-328) | 162-182 av. 169 (167-175) | 44-46 av. 45 |
| 10 ♀♀ | 331-369 av. 354 (323-364) | 173-201 av. 193·6 (169-198) | 44-51 av. 48 |

In IND. HANDBOOK (1 : 346), the measurements are :—

| | | |
|---|---|---|
| ♂♂ | 316-335 | 164-183 |
| ♀♀ | 357-370 | 186-210 |

According to the literature available, the sexes are similar. Whereas in the juveniles the sexes only differ in size, in the five adult males the white of the chin and breast extends to the lower belly which is marked with fine dark streaks, while in the four adult females the white is restricted to the chin and upper breast, the lower parts being brown as in the juveniles. In the pullet, the head is heavily marked with pale buff and the tail is more broadly tipped with white than in any of the others.

209 **Falco peregrinus japonensis** Gmelin (flew on board off Japan) Peregrine Falcon (**5** : 32 as *F. p. calidus*)

14 : 9 ♂♂ 5 ♀♀ (5 ad. grey above)

1 *Baghdad* ; 1 Wazirabad, 1 Punjab ; 1 Kutch ; 2 Bombay, 1 Kihim, Kolaba ; 1 *at sea between Bombay and Aden* ; 1 North Kanara ; 1 Malabar Coast ; 1 Kondakarla, Vizagapatam ; 1 Bihar ; 1 *Peking, China* ; 1 no data.

The subspecific identity of the real peregrine wintering in India still appears uncertain. Jerdon and Blanford noted it as *peregrinus* and

the specimen from Kihim, Kolaba District, was said to be of the nominate form by Whistler, working in England in the mid-thirties. Stuart Baker said they were *calidus*, and this is confirmed by Vaurie in 1965. Ripley has called them *japonensis*. With the material available, it is impossible to express any opinion, but I am leaving them as in the SYNOPSIS and IND. HANDBOOK. This group includes all the specimens which have their underparts white, excluding those either deep rufous below with dark heads and cheeks (*peregrinator*) or a paler rufous below with rufous on the nape and on the cheeks (*babylonicus*).

While they all fit into compact groups, this arrangement leaves no juveniles of *peregrinator*, and it is possible that some adjustments are necessary.

Specimen No. 12113 was taken at sea between Bombay and Aden, and is possibly the bird listed in Blanford (**3** : 416) as *peregrinator*.

Specimen No. 12114 a juvenile female from Peking, China, is left among the peregrines as originally marked, but it differs from all the others in the first primary on one side (it is broken on the other) being shorter than the third and in all the tail feathers being unbarred brown as in *F. jugger*. However, it has the heavy cheek stripe of *peregrinus* and the bill (27 mm.) and mid-toe (58 mm.) are too large for *jugger*, which further does not appear to have been recorded in China.

The measurements of the 3 races are :—

| | Wing | Tail | Tarsus |
|---|---|---|---|
| ♂♂ | *japonensis* | | |
| | 309-319 av.<br>(297-316 *calidus*) | 138-159 av.<br>(134-145, BR. HANDBOOK 130-158) | 48-54 av. (49-51) |
| | *babylonicus* | | |
| | 270<br>(273-284) | 122<br>(126-135) | 48<br>(45-46) |
| | *peregrinator* | | |
| | 274, 285, 289<br>(265-295) | 121, 127, 131<br>(128-162) | 47, 49, 52<br>(48-50) |
| ♀♀ | *japonensis* | | |
| | 344-362 av. 354<br>(344-379) | 162-169 av. 167 | 51-58 av. 54 |
| | *babylonicus* | | |
| | 319, 324, 329<br>(320-338) | 148, 156, 158<br>(151-158) | 52, 54, 55<br>(53-55) |
| | *peregrinator* | | |
| | 333<br>(312-342) | 153 | 54 |

210 **Falco peregrinus babylonicus** P. L. Sclater (Oudh) Redcapped Falcon 5 : 36

4 : 1 ♂ 3 ♀♀ (one by size).

1 Ambala, Punjab ; 1 Radhanpur, 1 Gujerat ; 1 no data.

The three females were mixed up with the other peregrines, but all have a varying amount of rufous on the nape and on the cheeks. The measurements are tabled under the preceding form.

211 **Falco peregrinus peregrinator** Sundevall (Indian Ocean, off the Nicobar Islands) Shahin or Indian Peregrine 5 : 34

4 : 3 ♂♂ (one by size) 1 ♀.

2 Simla Hills, 1 Bokloh, Punjab ; 1 Karnala Fort, Pen, Kolaba.

The last bird which was evidently breeding is the darkest rufous on the underparts and smaller than the other two from the Punjab—wing 274, cf. 285, 289 ; tail 121, cf. 127, 131. Other details of measurements are tabled under *japonensis.*

212 **Falco subbuteo subbuteo** Linnaeus (Sweden) Hobby 5 : 42

11 : 2 ♂♂ 8 ♀♀ 1 o ? chick (4 juvenile ♀♀).

1 *Azizeih, Tigris, Mesopotamia* ; 1 Chitral ; 3 Simla, NW. Himalayas ; 1 Mashobra, Koti State ; 4 Bombay ; 1 *Tiddin, Burma.*

| | Wing | Tail |
|---|---|---|
| ♂♂ | 257, 271 (245-265) | 131, 139 (129-142) |
| ♀♀ | 261, 262, 265, 269 (273-280 BR. HANDBOOK 265-280) | 115, 131, 136, 136 (146-148) |

The two males show almost no sign of barring on the tail. In the adult females the collar is more pronounced than in the males, which are also more completely grey above.

213 **Falco subbuteo centralasiae** (Buturlin) (Baimgol, Tianshan) 5 : 42

1 ♀ *Langar, Yarkand.*

Specimen No. 12153 is slightly paler above than the other females and also has a larger wing 276 (277-286). The original label indicates a weight of 8·3 oz.

214 **Falco severus rufipedoides** Hodgson (Nepal) Indian Hobby 5 : 47

3 : 1 ♂ 2 ♀♀ (one by size)

1 Bhutan Duars; 1 Sibang, Darjeeling; 1 Tegu, Lohit Valley.

| | Wing | Tail |
|---|---|---|
| ♂ | 205 (211-219) | missing (94-95) |
| ♀♀ | 240, 247 (237-248) | 112, 114 (105-112) |

215 **Falco severus severus** Horsfield (Java) Burmese Hobby 5 : 45

5 : 3 ♂♂ (one by size) 2 ♀♀ (by size)

1 Cachar, Assam ; 1 *Pokkoku, Upper Burma* ; 1 *Pegu*, 2* *Thaung Valley, Amherst, Burma.*

♂♂ Wing 216*, 218, 222 (not available in FAUNA or in IH) Tails 90, 95*.

♀♀ ,, 233*, 243 (IH 221-245·5) Tails 108*, 109 (IH 95-115).

The two from Thaung Valley though not sexed are marked as shot off a nest on the same day and are no doubt a pair. The birds north of the Brahmaputra are said to be paler on their underparts (*rufipedoides*)

but I am unable to see any differences in the small number available which are now separated entirely by their places of origin.

216 **Falco concolor** Temminck (Senegal etc.) Sooty Falcon

2 ♂♂ Both with rufous on underparts, obtained from Muscat Museum.

These specimens were found listed with *Falco subbuteo.*

217 **Falco columbarius insignis** (Clark) (Fusan, Korea) Merlin **5** : 49

218 **Falco columbarius christianiludovici** Kleinschmidt (Caucasus) **5** : 50

4 : 2 ♂♂ 2 ♀♀ (1 adult ♂).
2 Wazirabad, Punjab ; 2 *Peking, China.*

The two birds from the Punjab, one of which died in captivity, though originally correctly identified as to species were listed under *Falco tinnunculus* and *F. chicquera.* The subspecific identification is difficult, but the Punjab female is slightly paler than that from Peking. It is probable that the Punjab birds are *christianiludovici* and those from China are *insignis.*

219 **Falco chicquera chicquera** Daudin (Bengal) Redheaded Merlin **5** : 47

21 : 10 ♂♂ (2 by size) 11 ♀♀ (2 by size) (1 pullet, 2 juvenile).
1 Waziristan, 1 Chaklala, N.W.F.P. ; 1 Wazirabad, 1 Sadhoki, Gujranwala, 1 Dhulkot, Ambala ; 1 Delhi ; 1 Gwalior ; 1 Radhanpur, 1 Kutch, 1 Ahmedabad ; 1 Thana, 1 Kolaba ; 1 Palghat, Kerala ; 3 Tirhut, 1 Darbhanga, Bihar ; 1 *Upper Burma* ; 3 no data.

| | Wing | | Tail | |
|---|---|---|---|---|
| ♂♂ | 194-204 | av. 199 (IH 190-207) | 120-132 | av. 126 (IH 124-137) |
| ♀♀ | 221-236 | av. 227 (IH 220-232) | 143-155 | av. 150 (IH 148-156) |

The two juveniles have their heads darker than the adults. The females are a clearer grey above than the males.

220 **Falco vespertinus amurensis** Radde (Amur) Redlegged Falcon **5** : 58

3 : 2 ♂♂ 1 ♀
1 Ambarnath, Thana, Maharashtra ; 2 Cachar.

EL **Falco naumanni naumanni** Fleischer (Southern Germany) Lesser Kestrel

3 ♂♂
1 *Katunak, 8 miles south of Shiraz, Iran* ; 2 *Ruauda, Tanhat, Yemen, Arabia* (Philby 1940).

These three birds are distinctly paler, both above and below, than those listed *pekinensis*, and have been identified as *C. naumanni naumanni* by Whistler. The Iraq and Persia specimens under 221 were recorded (*JBNHS* **28** : 420) as of the nominate race, but cannot be separated from birds from Manipur and Orissa which are presumably *pekinensis.* Both races are accepted in Western Asia in Peters (**1** : 298) but Vaurie (p. 234) does not recognise *pekinensis.*

221 **Falco naumanni pekinensis** Swinhoe (Near Peking, China) Lesser Kestrel **5** : 66

10 : 6 ♂♂ 4 ♀♀.

4 *Felujah*, 2 *Sulaimaniyah*, *Iraq* ; 1 *Persepolis*, *Persia* ; 2 Balasore, Orissa ; 1 Manipur.

Specimen Nos. 12265, 12266, and 12267 collected by C. R. Pitman are all in male plumage. Except for the date '25-6-1917' on two of them, there are no other data. In 'The Birds of Mesopotamia' (*JBNHS* **28** : 420) reference is made to 3 females and a male collected by Pitman at Felujah between 8 and 16 April 1917. A fourth bird of this species in female plumage also bears the date '25-6-1917' and was collected by Pitman. The date of Pitman's other specimens show that he was in Mesopotamia on 25 June 1917 and, though the sexes are wrongly quoted, the present specimens which do not bear any field or original (?) labels are no doubt identical with those referred to in the above-mentioned paper as of the nominate race. Two females were incorrectly listed as *Cerchnis tinnunculus.*

222 **Falco tinnunculus tinnunculus** Linnaeus (Europe, restricted Sweden) Kestrel **5** : 61

223 **Falco tinnunculus interstinctus** McClelland (Assam) **5** : 61

83 : 38 ♂♂ 40 ♀♀ 5 o ?

2 *Sheik Saad*, 1 *Amara*, 2 *Baghdad*, 1 *Razani*, 1 *Shatt-el-Adhain*, 1 *Hit*, 1 *Tobbat*, *Mesopotamia* ; 4 *Mishim*, 1 *Tagoira*, *Persian Gulf* ; 2 Shiraz, 1 Shustar, Persia ; 1 *Quasarquand*, *Persian Baluchistan* ; 1 Boya, 2 Quetta, 1 Wana, 2 Chitral, N.W.F.P. ; 1 Kashmir ; 14 Simla, 1 Keonthal, 1 Patiala, 1 Dakuri (?) 8900′, 1 Bahawalpur, 1 Ludhiana, 1 Delhi ; 1 Joshinathi, 1 Chamoli, Garhwal, U.P. ; 1 Kaira, 1 Dwarka, 2 Cambay, 1 Baroda, Gujerat ; 3 Nasik, 3 Bombay, 2 Thana, 1 Kolaba, 1 Poona, 3 Khandala, 2 Panchgani, 1 Malwan, 1 Sawantwadi ; 1 Coonoor, 1 Kurnul, 2 Madras ; 1 Baghowni, Tirhut, 1 Rajputtee, Saran ; 1 Phalut, Darjeeling ; 1 Dimapur, 1 Imphal, Manipur ; 2 *Upper Burma*, 1 *Yarkand*, 2 *Peking*, *China*.

The two from Peking are both males, one in first year and the other in adult plumage. The former is as dark as *objurgatus* but with a duskier and more smoky effect. The adult can be compared with others from India. With the material and literature available, I am unable to separate *interstinctus* from *tinnunculus* in the large series.

Five of the females including specimens collected by Jones and Capito have grey heads and cannot be distinguished from males ; this is a character not accepted for the nominate race.

Three females from Panchgani and Madras (2) collected in March, January, February are exceptionally red above.

224 **Falco tinnunculus objurgatus** (Baker) (Ootacamund, Nilgiris) Indian Kestrel **5** : 65

8 : 4 ♂♂ 3 ♀♀ 1 o ?

2 Bhimashankar, 1 Lohgarh Fort, Poona ; 4 Kodaikanal, 1 Palnis.

These birds can be picked out from the large series by their darker colour both above and below. The three males from the Palnis in different plumages, differ from the others in having rufous thighs, a character not visible in any of the others of this and other races.

(*to be continued*)

# A new Begonia from East Nepal

BY

C. R. Rao

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(*Communicated by Prof. P. V. Bole*)

(*With a plate*)

**Begonia tribenensis** sp. nov.

Affinis *B. modestiflorae* Kurz, differt tamen inflorescentia breviore ramosioreque, foliis omino orbicularibus, solitariis vel binis e tubere; caulibus aereis nullis.

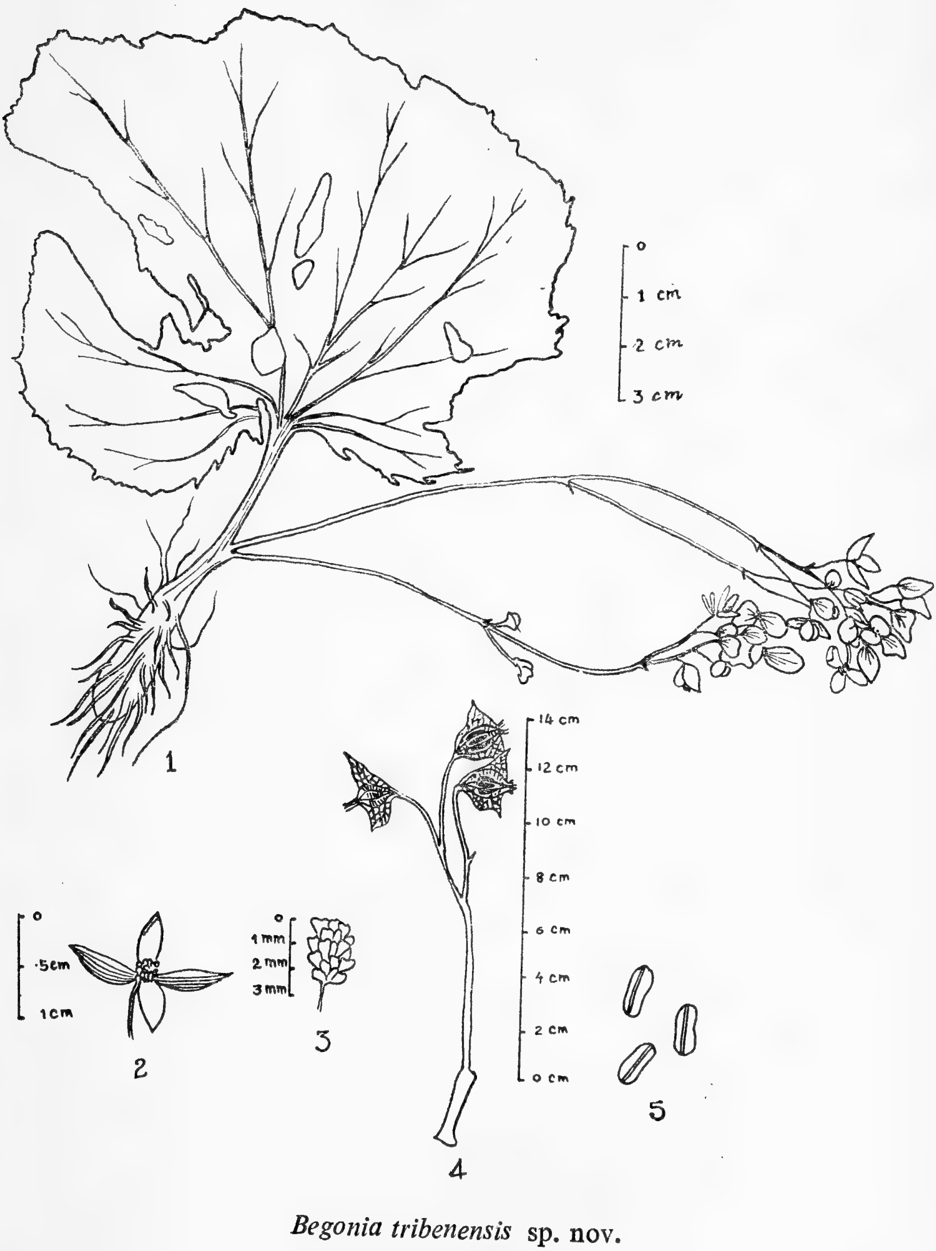
*Herba* tuberosa generatim folio solitario. *Tuber* solitarium, oblongum, 6-9 mm. diam., brunneum. *Radices* rarae, graciles, 2-3 cm. longae. *Folia* 10·5 cm. diam. orbicularia, nervis palmatis et praecipuis in medio furcatis; petioli 2·5 cm. longi, rosei. *Flores masculi*: *Sepala* 2·7 mm. longa, carinata, glabra, marginibus subundulatis, nervis 8-10. *Petala* 2·7×4 mm. alba, obovata, marginibus subundulatis, 3-nervia. Pistillodium nullum. *Stamina* 28, monadelpha, clavata, paulum inaequalia, filamentis brevibus, antheris 1 mm. longis, bilocularibus, pollinis granis linearibus. *Flores feminei*: ignoti. *Fructus*: Capsula tribus alis ornata quarum una apiculatior; alae 1·3 cm.×6 mm. loculi 3, singuli divisa placenta ornati; tepala papillosa.

Typus, *Rao* 342 A. lectus in via a Barakshetra ad Tribeni ad altit. 130 m. in dist. Sunsari in Nepalia orientali die 6 julii anni 1963 et positus in BLAT. *Rao* 342 B, isotypus positus in herbario Begoniarum Asiaticarum Professoris E. Irmscher ad Hamburgum in Germania Occidentali. Paratypi, *Rao* 832 A, 832 B, lecti eodem in loco die 30 julii, 1967, positi in BLAT.

**Begonia tribenensis** sp. nov.

Allied to *B. modestiflora* Kurz, but differs in having shorter and more branched inflorescence, leaves all orbicular; usually one or two from a tuber. Absence of an erect leafy stem.

Mostly single-leaved tuberous herbs. *Tuber* single, oblong 6-9 mm. diam., brown. *Roots* few, thin, 2-3 cm. long. *Leaves* 10·5 cm.




*Begonia tribenensis* sp. nov.

in diam., orbicular, palmately veined, main veins forking midway; petiole 2·5 cm. long, pinkish. *Male flowers*: *Sepals* 2·7 mm. long, keel shaped, with slightly wavy margins, glabrous, veins 8-10. *Petals* 2·7×4 mm. obovate, white, margin slightly wavy, veins 3. Pistillode absent. *Stamens* 28, monadelphous, clavate, slightly differing in length; filament short; anthers 1 mm. long, dithecous with linear pollen grains. *Female flowers*: not seen. *Fruit* three-winged capsule; one wing more apiculate than others, wing 1·3 cm.×6 mm.; trilocular, each locule with a divided placenta; tapels with papillae. (Plate).

Very rare, on rock-cut surfaces, in shade. Flowering: June-July; Fruiting: August-September.

*Rao* 342 A from Barakshetra to Tribeni (±130 m.) Sunsari District, East Nepal, 6th July 1963 is the Holotype (Blatter Herbarium); *Rao* 342 B Isotype, Professor E. Irmscher's herbarium of Asiatic Begonias, Hamburg, W. Germany. *Rao* 832 A, 832 B Paratypes, Blatter Herbarium, Bombay.

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# An Introduction to the Study of Indian Spiders

BY

T. V. SUBRAHMANYAM

(*With fourteen text-figures*)

[*Continued from Vol.* **65** (2) : 453]

## HABITS AND HABITATS OF COMMON INDIAN SPIDERS

### Mygalomorphic Spiders

Mygalomorphic spiders can be distinguished at once by the peculiar articulation of their chelicerae, somewhat squarish and prominent cephalothorax, transverse median groove, leg-like palpi and general sepia or brown colour of the body. The Indian mygalomorphs are but poorly known as these spiders are, without exception, nocturnal and remain concealed in their shelters, under stones and rubbish or holes by the buttress roots of trees, during the day. Many live in special burrows lined with silken thread. Some are mere wanderers hiding amidst debris or under stones. Some live in simple excavations lined or unlined

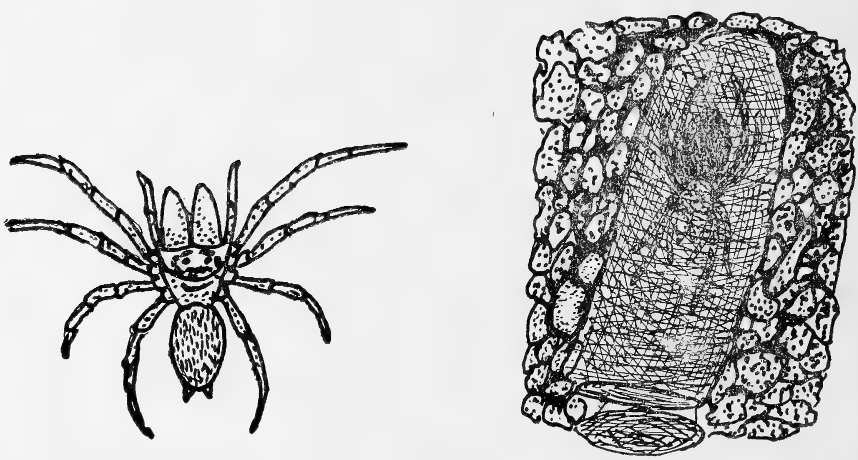


Fig. 1

A typical mygalomorph — Trap door spider

with silk (Fig. 1). Others have deeper holes containing silk tubes which remain open or are closed by trap-doors.

**Arachnomorphic Spiders**

Any open garden or meadow in the country side, margins of rivers or lakes, with thick vegetation fields and scrub jungles are all excellent places for collecting spiders.

Family Filistidae. Cribellate spiders represented by the genus *Filistata.* The general colour is brownish or yellow. The eyes are compact, the integument is smooth and the legs somewhat long and tapering. These spiders are found in termite runs on tree trunks and under bark of trees ; also in the deserted nests of Dictynids.

Family Urocteidae. The family is represented by the genus *Oecobius.* Members of this genus are small spiders weaving patches of webs under stones or in holes and angles of walls. In habit they resemble Dictynids and can be caught likewise. They feed on small ants and insects. The spider circles round and round the prey and completely winds it with silk before sucking the juice.

Family Eresidae. The large untidy webs of the Indian colonial eresids are a common feature along fences, over bushes or attached to extremities of tree branches. These webs resemble shapeless masses of bath sponge or irregularly folded white rags. From the central permanent web, extensions are often made in the form of loose nets or sheets. Hundreds of medium-sized spiders can be seen on the outskirts of a nest especially towards the evening, industriously moving about, some engaged in repairing the snares, others dragging their prey. The threads constituting the nest as well as the sheet are highly sticky and any bee or fly coming into contact with them can never escape. The nest is hollow within and is reinforced by a number of silken strands closely wound along with dry leaves and carcasses of dead flies. A number of holes on the surface lead into the nest. When disturbed the spiders immediately withdraw through the holes into the nest.

The fertilized female deposits her cocoon inside a small nest formed of a few strands. On hatching the young ones enlarge the initial nest and the colony increases in number and size from fresh broods. ' As the younger generations grow up the older members die or some of them go off to found another colony '.

For collection, pull the entire nest and after tearing it shake over the open spirit jar ; you are sure to obtain enough specimens.

The only genus found in India is *Stegodyphus* and four or five species have been recorded. Of these the most widely distributed species is *Stegodyphus sarasinorum.* Members of this species are greyish white with a median white line on the abdomen. Males are darker and smaller. The size of the female is about 10 mm. and the first pair of legs measure as much as the body length. This species is common in Kerala, Mysore,

Madras and in western India. An allied species *Stegodyphus socialis* slightly larger in size with the abdomen shiny yellow above and black below has been recorded from south India, particularly Bangalore.

Two other species recorded from western India are *S. mirandus* and *S. pacificus*. Both are large forms measuring 20 mm. in length. The former has its carapace and limbs blackish covered with olive black hairs and abdomen bronze-black above and golden red at the side and below. The latter is yellowish red, clothed with greyish hairs, legs banded black and abdomen with a pair of irregular longitudinal black bands above and at sides.

Family Psechridae. Represented by the Genus *Psechrus* characterised by the extraordinary length of the first two pairs of legs. *P. alticeps* is the common species found in the damp jungles of Kerala. It is a fairly large spider brownish in colour with long slender legs. It spins a large, irregular web attached to trees or rocks and sits in the centre in an inverted position. By the tapping method the spider can be made to drop into the jar but if your approach is not quick the spider escapes.

Family Uloboridae. Represented by the Genus *Uloborus*. Several species are included in this genus but a somewhat large one *U. geniculatus* (Fig. 2) is very common especially below the thatched roofs of the out-houses and stables in Kerala districts. *U. geniculatus* is a pale brown species, with a tapering abdomen and thin long legs carrying distinct black spines at the joints. The eyes are set on tubercles. The web is circular like that of Argyopids with a beautiful flocculent lace-like centre.

Family Dictynidae. Represented by the genera *Dictyna* and *Amaurobis*. Members of the genus *Dictyna* are small-sized spiders. Some of them are brownish in colour while some are bright green with whitish mid-dorsal line on the carapace and lateral lines on the abdomen. They weave patch like webs of irregular strands on grass and herbage or in the angles of walls. When disturbed they scurry away. In view of their small size you cannot straightway tap them into the jar. The best way will be to gently pluck the leaf on which the animal rests and to transfer both into the jar. In the case of small forms found in corners of walls, moisten a piece of cotton with spirit and press it gently over the spider. The latter adheres to the cotton and it can be easily deposited into the jar.

Some forms spin untidy webs on leaves and twigs round about their lair. 'The lair is usually concealed in one or two curled leaflets of the common jungle shrub *Clycosmis*'.

Family Sicariidae (Scytodidae). A small group of six-eyed spiders usually with weak legs and slow, halting, movements. Members

of the genus *Scytodes* are common in India. They are small spiders measuring 8 to 9 mm. in length. On the carapace there are five or seven longitudinal dark lines and on the abdomen there are 3 or 4 transverse

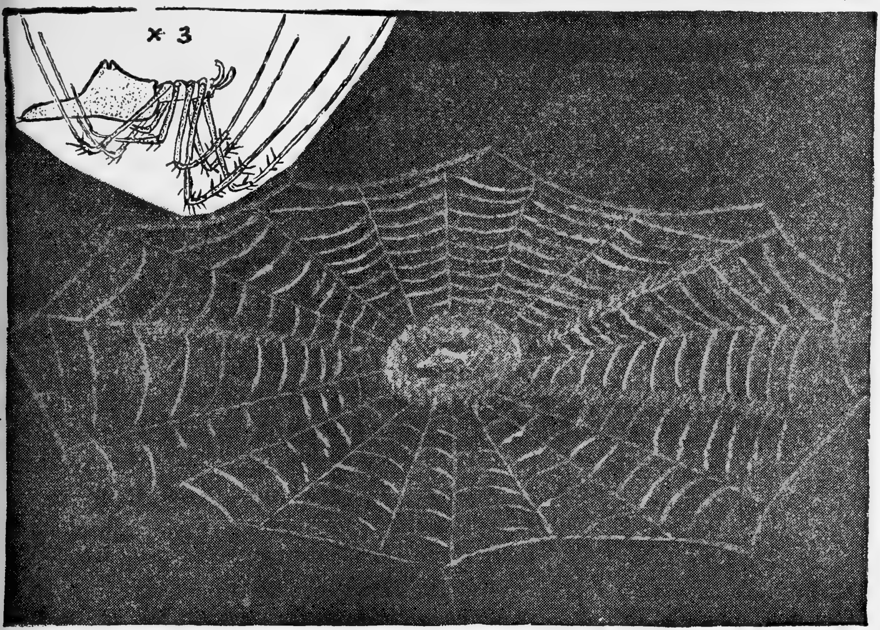



Fig. 2

*Uloborus geniculatus* and its web

black lines. They generally live among foliage by spinning together a few leaves.

Family D y s d e r i d a e. Represented in India by one genus *Ariadna*. Often found under stones and on loose soil where they spin long tubes of soft, but usually tough white silk. The cephalothorax is rather flat and abdomen long oval ; integument is smooth and soft.

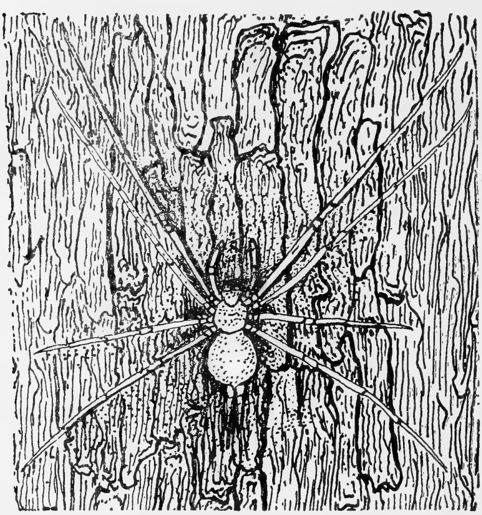
Family P a l p i m a n i d a e. Characterised by the great development of their anterior legs—generally used more for feeling than for locomotion—are represented by the genus *Saracellus*—a bright orange red spider found under stones or tree trunks. Members are small measuring only from 3 to 5 mm.

Family Z o d a r i i d a e. Medium-sized or small spiders with tarsus having 3 claws. *Hermippoides arjuna* is a medium-sized, round, black spider spotted white. *Sufficia cingulata* is a minute spider of 2·5 mm. running about among dead leaves. *Storena bilunifer* is a medium-sized

dark brown species with conspicuous ochraceous marking on abdomen. Found among soil and stones under shady trees in jungles.

Family Hersiliidae. Represented by the species *Hersilia savignyi*, (Fig. 3) very common on the trunks of avenue and jungle trees. The colour of these spiders matches that of the tree trunk and they closely adhere to the tree trunk with spread-out legs thereby concealing their presence. The collector can detect them by their prominent spinnerets. At the sight of man the spider moves sideways and when chased circles around the tree trunk and disappears into some crevice. It is very difficult to catch a hersiliid by tapping. By spraying a strong insecticide like ' flit ' you can make the spider fall down. It can also be caught in the fold of your kerchief.

Hersiliids feed on moths and ants and smaller spiders. I have once noticed the common Garden lizard *Calotes versicolor* preying on a hersiliid. As in other hunting spiders the web is also made of a few threads woven irregularly in the form of a patch over fissures of tree bark. The cocoon is generally laid in holes and crevices of trees.



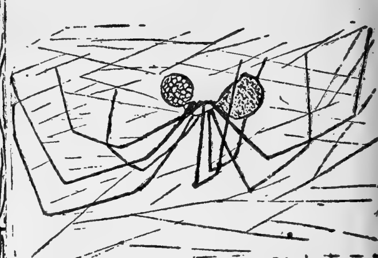


Fig. 3

*Hersilia savignyi* A pholcid spider with cocoon

Family Pholcidae. The Indian Pholcids (Fig. 3) comprises of four well-known genera : *Pholcus, Artema, Smeringopus* and *Crossopriza.* They are very common in unfrequented corners of roofs and rafters of outhouses, in caves and hollows of trees etc. Their exceedingly thin and long legs, prominent abdomen, expansive, untidy webs and the inverted position in which they suspend themselves, are all characteristic

of this family. In habits all the four genera are alike. The shape of the abdomen, however, shows great variation. In *Artema* the abdomen is fairly round, in *Crossopriza* short, oval, but prominent posteriorly above the spinnerets, and in *Smeringopus* and *Pholcus*, cylindrical. On the web being touched, the spiders oscillate their body up and down like the garden harvestman (Phalangidae) and try to escape by running or even shamming death. They can be easily tapped into the jar but one should do so with care as their legs are extremely brittle. Cocoons are spherical and are generally carried in the mouth.

Family Theridiidae. A large but heterogeneous group containing many small-sized spiders. In many important points of structure they agree with Argiopids but their webs are always irregular. Theridiids are common both in corners of houses and among foliage (Fig. 4).

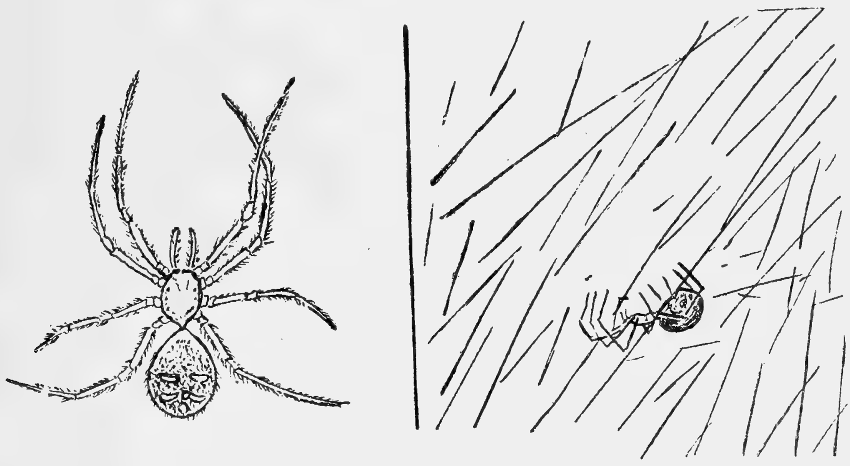


Fig. 4
Therid spider and its web

Some curl up dead leaves or construct an inverted wine-glass like silken tube for their shelter. Several forms belonging to the genus *Argyrodes* are commonly parasitic on the circular snares of Epeirid spiders between the rays of which they spin their own irregular webs. Theridiids are timid and shy and they can be easily secured by tapping.

Families Tetragnathidae and Argiopidae. In these two families of orb-weaving spiders we come across several interesting and curious genera which present great variation in size, shape, coloration and habits. Some species are so small that they cannot be studied without a lens. On the other hand there is the well-known species *Nephila maculata* whose body-length measures more than 2 inches.

Most of the members weave plain, circular snares suspended vertically, obliquely or horizontally among plants and shrubs or between branches of trees. These orb-webs vary considerably with different genera. Some webs are small with a few radii and spirals ; some are large ornamented in the centre with silken lace work and zig-zag lines (*Argiope*) ; some have a diametrical line of debris (*Cyclosa*) and some are perfect domes with accessory reinforcements and suspensions (*Cyrtophora*). Some genera, e.g., *Araneus*, *Tetragnatha* etc. are nocturnal in habits, whereas *Argiope*, *Cyrtophora*, *Nephila*, *Leucauge* etc. remain in their webs permanently and get away from them only when disturbed. In species like *Nephila* sexual dimorphism is ' greatly pronounced '. There are long legged forms and short legged ones. Smooth skinned, prettily coloured species and also those with hard integuments drawn into spines, tubercles, and prominences. Altogether in view of such wide variations the collection of Tetragnathids and Argiopids is difficult in some cases and easy in others.

The more important genera that are commonly found in Bombay and other districts in western India (including Kerala) are *Tetragnatha*, *Orsinome*, *Eucta*, *Leucauge*, among Tetragnathidae and *Nephila*, *Argiope*, *Cyrtophora*, *Cyclosa*, *Araneus*, *Herennia*, *Ordgarius*, *Gasteracantha* among Argiopidae.

The Tetragnathidae are moisture loving spiders which resemble each other in general structure and habits. They are common among plants and hedges especially on vegetation fringing pools, tanks and wells and among grass and herbage growing in water-logged localities.

The extraordinarily developed chelicerae, the cylindrical abdomen and the long, slender legs stretched fore and aft in linear fashion distinguish the genus *Tetragnatha*. Generally nocturnal, the spider leaves its orb-web during the day and hides on the underside of a leaf or grass blade. At dusk, however, it comes out of its hiding place, repairs and reinforces the web with fresh threads and occupies the centre.

There are about ten species of *Tetragnatha* recorded from India and *Tetragnatha gracilis* (Stoliczka), *T. mackenziei* Gravely, *T. mandibulata* Walck., *T. viridorufa* Gravely, and *T. cochinensis* Gravely are commonly found in western India.

The disposition of the eyes, the nature of the chelicerae and the arrangement of the spines over them vary widely in the different species and are of taxonomical value.

*T. gracilis* has its lateral eyes prominent and the fangs and the mandibles comparatively short. The total length (carapace and abdomen) does not exceed 12 mm. Common in jungles, and even during the dry months of April and May they are found in large numbers on the withering twigs of garden plants. One peculiar habit of this species is that it constructs its web on either side of a small twig, the twig itself forming

a diametrical reinforcement of the web. The colour of the spider invariably matches that of the twig and it is difficult to spot the creature when it sits stretched along the twig. But as these spiders are chiefly nocturnal they can be seen towards sunset actively repairing the old or constructing new webs around the small terminal branches of plants. It appears that this species prefers plants with sparse leaves to those with thick foliage for the construction of the webs.

In *T. mackenziei* the abdomen is greyish and carapace and legs yellowish green.

*T. mandibulata* (Fig. 5) is another common species found on plants overhanging pools and tanks. The spiders generally hide under grass blades or along twigs, stretching their legs in the characteristic tetragnathid fashion. Fully grown specimens measure 13 mm. The fangs are well developed and provided with two small teeth. The general colour is brownish yellow.

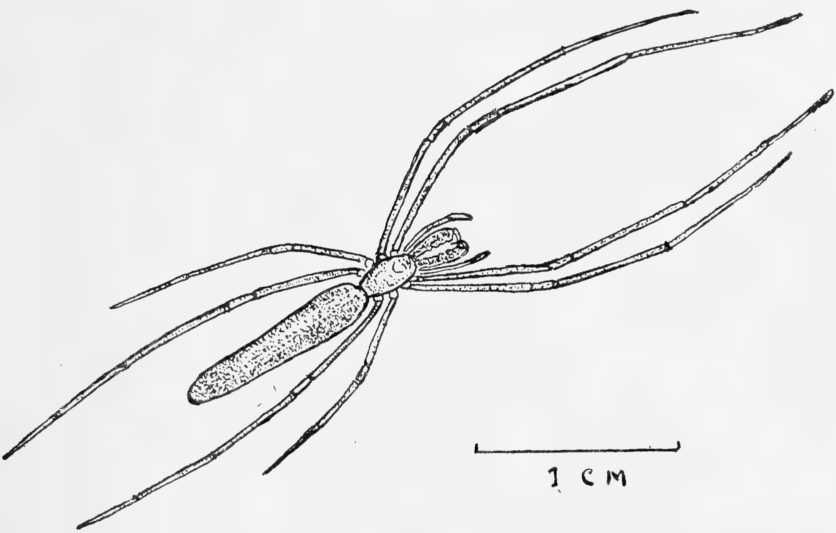



Fig. 5

*Tetragnatha mandibulata*

*T. viridorufa* is a nocturnal species found among leaves and twigs of jungle trees. The abdomen is long and tubular, more or less squarish in cross section. The sides of abdomen are coloured green whereas the dorsal side and legs are reddish brown. Males and females do not differ much in size. While mating they grasp each other by their chelicerae. The female tucks her abdomen towards her mate while the latter injects the sperms into her orifice applying his right and left palpal organs alternately during the act of copulation.

*T. cochinensis* has a slender but long body measuring about 12 mm.

A common species found usually hiding under plantain leaves is *Eucta javana* Thorell (Fig. 6). It has a pair of weakly toothed chelicerae, long slender legs and a very remarkable abdomen produced behind the spinnerets into a long tapering ' tail '. *Ariamnes similans* recorded from Calcutta resembles *E. javana* in general shape but its tail and abdomen are green in colour with silvery and yellowish brown markings. The general colour of *E. javana* is pale brown.

*Orsinome marmorea* Pocock resembles *E. javana* but has a rounded abdomen. About the habits of these spiders Dr. Gravely states ' *O. marmorea* spins large and more or less horizontal webs between rocks above rapidly running streams at an altitude of about 1500 ft. in the Cochin Ghats. Several webs are usually grouped together ; often they are stretched above waterfalls. When the spiders are disturbed they fall into the water, which washes them away. When they reach a rock they cling to it, and remain an inch or two below the surface till danger is over. Males and females were sometimes found together in the middle of a web with their heads in contact. Presumably they were pairing but I had not time to investigate this fully '.

The genus *Leucauge* includes several interesting species measuring 6 to 12 mm. in length. All of them possess a row of long hairs on the femur of the 4th pair of legs. The body is beautifully coloured with shining silver over a greenish black background. They are chiefly grass spiders building oblique or horizontal webs and sitting at the centre in an inverted position. They are mostly diurnal and their mating habits are similar to those of *Tetragnatha*. Cocoons are long and egg-shaped and are attached to leaf blades or leaves on which the spider sits.

The following species are recorded from India : *Leucauge fastigata* (Simon) ; *L. tessellata* (Thorell) ; *L. celebesiana* (Walck.) ; *L. ventralis* (Thorell) ; *L. culta* (Cambr.) ; *L. decorata* (Blackwall) ; and *L. bengalensis* (Gravely).

In Bombay *L. decorata* (Fig. 6) is found in large numbers in shady places among bushes and herbage. The abdomen has a pair of black coloured tubercles, or shoulders at the anterior end. The posterior end of the abdomen is also black. Rest of the dorsal side, and the flanks are silvery with a few longitudinal black stripes. In fresh specimens the silver tint is sometimes mixed with an additional pubescent tinge of yellow giving it a golden appearance. On the ventral side the anterior portion is bright green and posteriorly there are silver dots over a black background. Legs and carapace are light green, striped black at the joints. The spinnerets, claws, and the hairs on the legs are black. Chelicerae are brownish yellow.

The Argiopidae includes some large-sized forest dwelling forms of the genus *Nephila*. Under this genus four species are recognised but

the one commonly found in western Indian jungles, especially during the rainy months, is *Nephila maculata* or the Giant Wood Spider (Fig. 7).

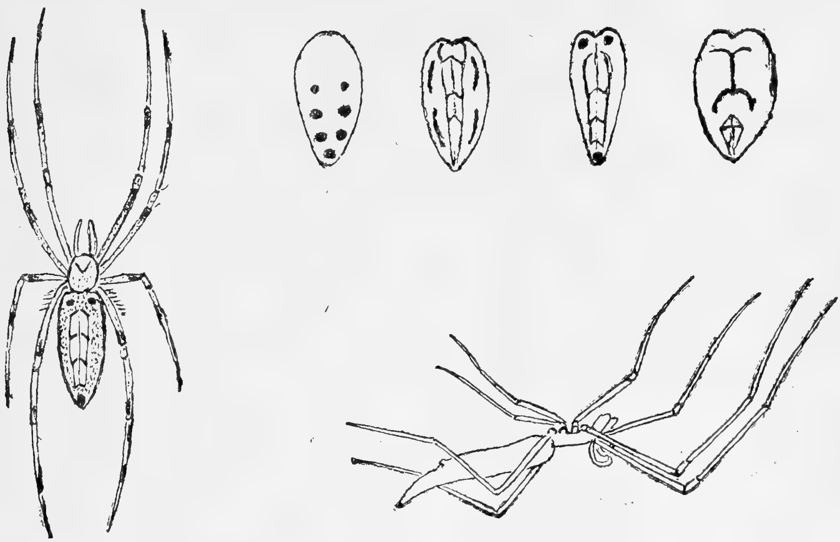


Fig. 6

*Leucauge decorata* *Above*: Different types of abdomen of *Leucauge* sp.
*Below*: *Eucta javana*

The female is verily a giant among spiders, with a body measuring more than 2 inches in length and ¾ inch in breadth. When the legs are stretched fore and aft they cover a length of about 6 to 7 inches. The abdomen is an elongate, truncated cone, black with longitudinal yellow stripes on the dorsal side or orange patches on the ventral side. The spinnerets are prominent and form a brown rosette. Above this there is a deep red rosette. Legs are also black, decorated with yellow dots at the joints. Mandibles are brownish-black or reddish. Males are insignificantly small and dull-coloured. In no other group of spiders is the disparity in size between the sexes so greatly marked. The web of the female is a giant wheel with a hub, radii and spirals, geometrically woven within strong boundary lines attached between trees. The spider generally sits in the centre of the web. To catch a *Nephila* is not very difficult. With a long hook pull the web and down comes the spider. Being a slow runner it can be seized in the folds of a kerchief and dropped into the spirit jar. Mating and other habits of *N. maculata* are elaborately described by Hingston (1922)[1].

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[1] Hingston, R. W. G. (1922) The Snare of the Giant Wood Spider (*Nephila maculata*). *J. Bombay nat. Hist. Soc.* **28**; 642-649, 911-923; **29**; 70-76.

*N. malabarensis* Walck. (Fig. 8), is common in Malabar but rare in Bombay. This species stands between *N. maculata* and *Araneus*. The

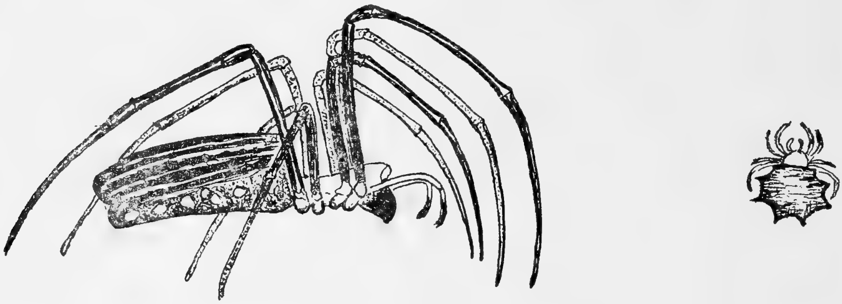

Fig. 7
*Nephila maculata* *Gasteracantha brevispina*

total length of this species is only 25 mm. The abdomen is oval with orange or yellow dots. Spinnerets stout and black and carapace is slightly raised and reddish in colour. Sternum V shaped and yellow. Legs—femur and tibia yellowish, tarsi blackish covered with fine hairs, joints striped black and brown. The first pair of legs about four times as long as the carapace whereas in *Nephila maculata* it is about six times as long. The spiders construct expansive orb-webs obliquely suspended at the angles of tree branches or on the exterior angles of country houses. Like *Araneus*, during daytime they remain concealed but at dusk come out to the centre of the web. The webs are permanent structures not renewed every night as in the case of *Araneus*.

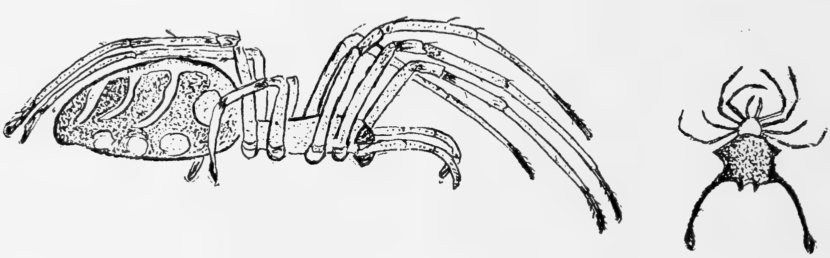

Fig. 8
*Nephila malabarensis* *Gasteracantha remifera*

The genus *Argiope* is the most important genus under Argiopidae. Some eight species are recorded from India and they differ little in habits. They are found in large numbers soon after the rainy months, sitting head downwards in the centre of their splendid orb-webs. The webs are vertically suspended over fences and vegetation. The spider

stretches its legs in the form of a letter X along four rays of the web. At least two of these rays are ornamented with flossy zig-zag bands. The size and shape of the abdomen and the colour design on it vary with different species although as a rule, in all cases the abdomen can be described as truncate in front and tuberculated at the sides posteriorly.

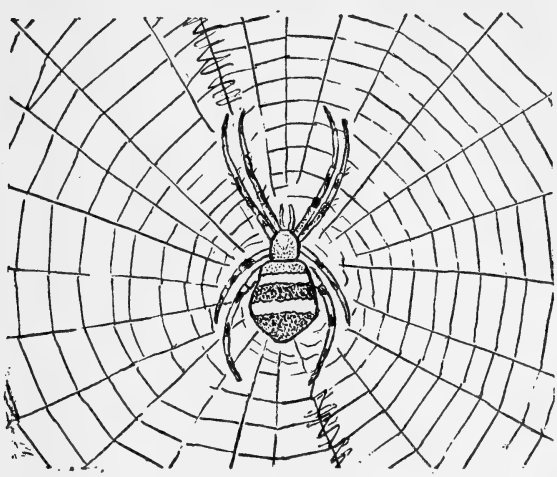

Fig. 9

*Argiope pulchella* *Araneus* hiding in a leaf

In *A. pulchella* (Fig. 9) which is the commonest species met with in Bombay, the abdomen is pentangular and banded alternately with brown and yellow. In *A. catenulata* the abdomen is truncate oval and ornamented with round spots instead of bands.

The male *Argiope* is considerably smaller than the female and is of a uniform brown colour. One or two males are often seen in the centre of their small webs built on the upper outskirts of the female web.

The cocoon of an *Argiope* is somewhat pentagonal in shape and slightly yellowish in colour. It is generally attached to the upper side of the web. Eggs hatch in about three weeks.

The commonest genus of Argiopidae, and the most abundant on trees and vegetation is *Cyrtophora*. This genus is closely allied to *Araneus*, but differs from the latter in some structural details and habits. *Araneus*, (Fig. 9) as a rule, has a round or oval abdomen and normal and strong legs. In *Cyrtophora* the abdomen is longer than wide and provided with four tubercles on the back. The abdomen is beautifully decorated with silver markings on a greenish black background, and slightly produced beyond the spinnerets. The legs are thinner and

longer than in the case of *Araneus* and further, they are coloured green. *Araneus* is nocturnal in habit and its snare is a plain orb-web woven afresh every evening and destroyed early in the morning. *Cyrtophora*, on the other hand, is diurnal and its web is a complicated structure of a permanent nature.

Although two or three species of *Cyrtophora* are recorded *C. cicatrosa* is the commonest of them all. This species is of gregarious habits, several of them build their webs in the same place, each member with its individual web remaining a separate entity. The web of *C. cicatrosa* can be described as a perfect dome of fine mesh-work suspended horizontally in the midst of a clumsy, irregular tangle of supporting threads (Fig. 10). The irregular threads are woven first and over these the radii of the orb are built and then the spirals. From time to time inter-radials and inter-spirals are laid which account for the fine and closely woven appearance of the web. The work of raising the centre of the web is done before the completion of the spirals. Cyrtophoran webs are described by Dr. Gravely thus 'Members of the genus *Cyrtophora* are remarkable for the extreme complexity of their webs which are probably more elaborate than those of any other spider. Instead of all the radial strands extending outwards from the hub, with interspaces consequently much wider near the periphery than near the centre, additional strands are inserted so as to produce a web of exceedingly fine and uniform mesh. Nor is this all, for these webs are supported in a horizontal position by an extensive network with the help of which the centre of the circle is more or less greatly raised above the periphery, thus forming a sort of tent or dome '.

The spider remains at the centre of the dome in an inverted position. The cocoons are egg-shaped. Eggs are laid in a small silk sheet somewhat greenish in colour, about an inch long and half an inch wide. The sheet is rolled in the form of an oval cocoon and suspended vertically right above the centre of the dome. Sometimes several cocoons are noticed serially suspended one above the other, but these do not belong to one and the same spider. The lowest one is the property of the spider living in the central web. Why the other spiders should deposit their cocoons in the same place where the first spider has placed hers, is baffling.

The genus *Cyclosa* includes several small species, measuring ½ inch and less in length with colour varying from jet black to fine silver. They have all the characteristics of typical argiopids but can be distinguished by the raised nature of the caput separated by a groove, the two or more prominences on the abdomen and a line of debris arranged diametrically across their vertically suspended orbs (Fig. 11). Their webs are common in bushes, sometimes near the webs of other spiders. In Malabar their webs are a common feature among the foliage of mango trees.

The immense genus *Araneus* (=*Epeira*) includes many common forms for the most part more or less nocturnal and having the same general

Fig. 10
*Cyrtophora cicatrosa* and its web

form and coloration as the common European garden spider of the same genus. The colour is often variable, the structure of the vulva affording the safest means of identification. Members are common

among plants and herbs. The best time to collect them is at dusk when they come out to spin their webs. With sunrise they dismantle the

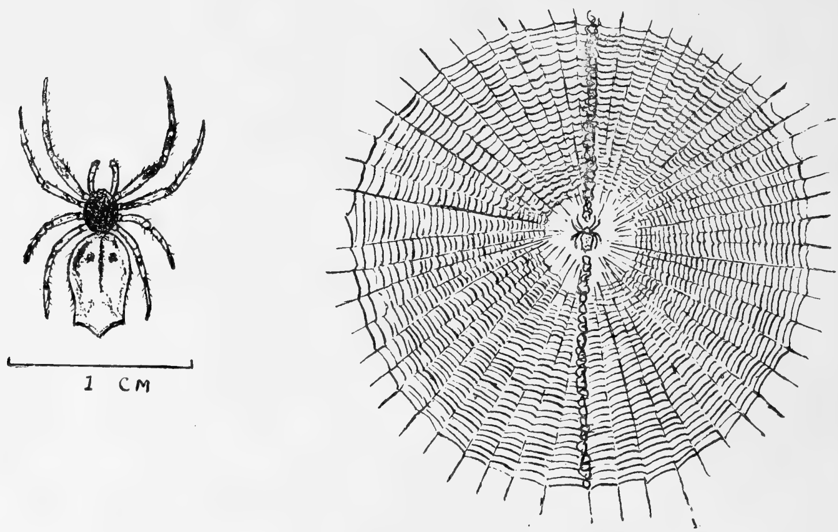


Fig. 11
*Cyclosa confraga* and its web

radials and spirals and keep a few radials, the hub and boundary lines alone intact. I have several times noticed *Araneus* eating their webs.

During daytime *Araneus* remains concealed in a crevice, curled up leaf, or a special shelter built by it near its orb-web. The cocoon is white and flat, and generally placed near its hiding place. The mother invariably sits over its cocoon presumably as a protection.

Genus *Herennia* is another arboreal genus distinguished by the flat pentagonal abdomen with sharply defined lateral edges. *H. ornatissima* is the common species found in Malabar. The abdomen is yellowish, ornamented with black spots. The carapace is blackish with yellowish margin. Legs are long and yellowish. Its orb-web is generally spun close to tree trunks.

Members of the genus *Ordgarius* have habits similar to those of the above or *Argiope*. The abdomen in this case is very prominent with a large protuberance on either side. The carapace is convex, armed above with a few symmetrically placed tooth-like tubercles. Two species have been recorded, *O. hobsoni* and *O. sexspinosus*. In the former the posterior end of the abdomen is rounded and in the latter it is tubercular and conical.

The genus *Gasteracantha* includes medium-sized spiders easily recognised by their peculiarly shaped abdomen covered with hard integument,

and the comparatively short legs. Abdomen varies in shape, and the hard integument is drawn into spines of varying sizes in the different species. Some ten species of *Gasteracantha* are recorded, and in habits they all agree with each other. *G. brevispina* (Fig. 7), *G. remifera* (Fig. 8) and *G. arcuata* are very common in Malabar. They build small orb-webs in a vertical plane among low plants and sit in them throughout the day. The spines of *G. arcuata* and *G. remifera* are exceptionally long. Their dull colour and the long spines and integument protect these spiders from their enemies.

Family Thomisidae. Field spiders dependent on plants and bushes. Some of them are beautifully coloured. Members are common inside flowers. The one species commonly found in Bombay is yellow or orange coloured with pentagonal body. The eyes are curiously arranged on a ridge. The abdomen posteriorly presents a laminated appearance. The tarsus of the first pair of legs which are used in gripping the prey are strongly spined.

Family Lycosidae. Hunting spiders of dull brownish general colour. An abundant group common on the ground in open fields, water-logged low-lying pastures and moist debris. *Hippasa*, *Pardosa* and *Lycosa* are the three important genera. Lycosids move about in a zig-zag manner and are difficult to collect. The common *Hippasa pantherina* (Fig. 12) unlike the other lycosids builds a conical tubular web in holes and natural crevices at the bases of trees. They generally sit at the mouth of their webs but retreat into their holes at the first sign of danger. For capturing them it is necessary to scoop out the entire tubular nest.

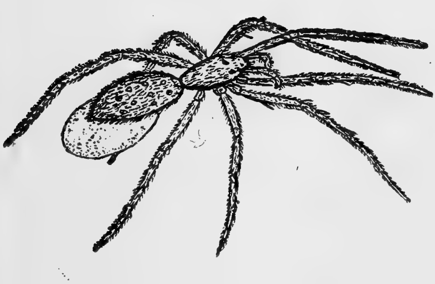

Fig. 12

*Hippasa pantherina* *Peucetia viridiana*

Family Sparassidae. A cosmopolitan family. Many species occur on tree trunks, under logs, stones, underside of leaves, in moist debris, in unfrequented corners of houses, in the nooks of almirahs and shelves etc. The common large House Spider found on walls and behind photo-frames, carrying a round biscuit-like cocoon, *Heteropoda venatoria* (Fig. 13) belongs to this family. Many other heteropodids are either of outdoor or cavernicolous in habits. *Palystes flavidus* (a green species) and *Olios tener* (light brown) are commonly found among leaves.

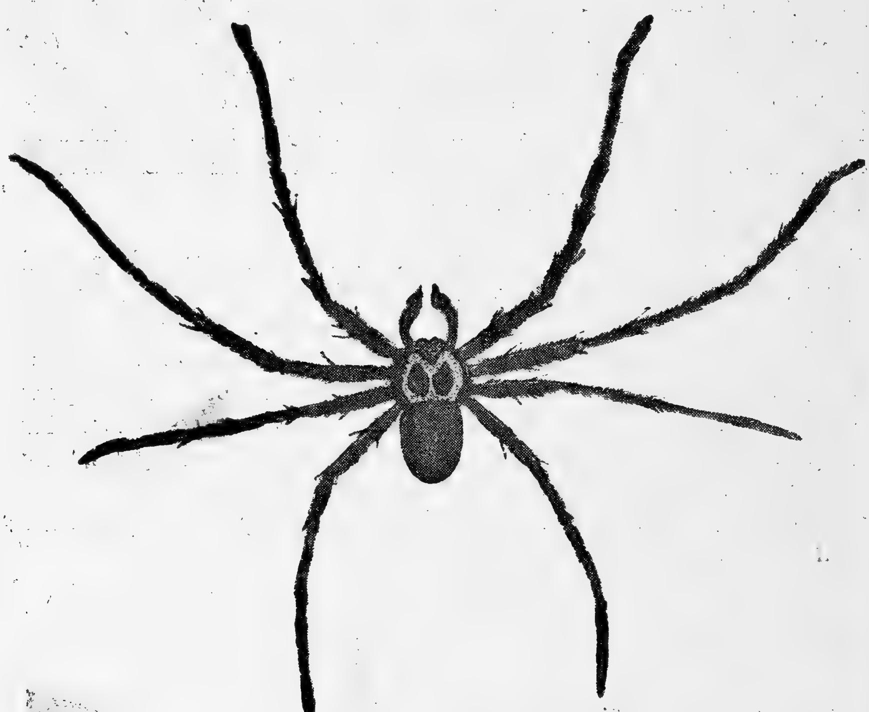

Fig. 13
*Heteropoda venatoria*

Family Clubionidae. Common in bushes residing in curled up leaves. Some are also found among dead leaves and debris and inside fissured bark at bases of trees.

Family Oxyopidae. A group of grass spiders easily detected by their conical abdomen, strongly spined legs, and raised head. Two species of the genus *Peucetia*, *P. elegans* and *P. viridiana* (Fig. 12) the former with abdomen yellowish brown with white streaks and the latter greenish are very common among herbage and ears of grass.

Family Attidae. Jumping spiders of medium size presenting different coloration and forms. They occur everywhere. On tree-tops and trunks, along walls and fences, on open ground, inside houses, sometimes inside garden flowers, and in hundreds of other places. Genus *Plexippus* (female brown and male ornamented with blackish design on the carapace and abdomen) is very common on walls. Many arboreal

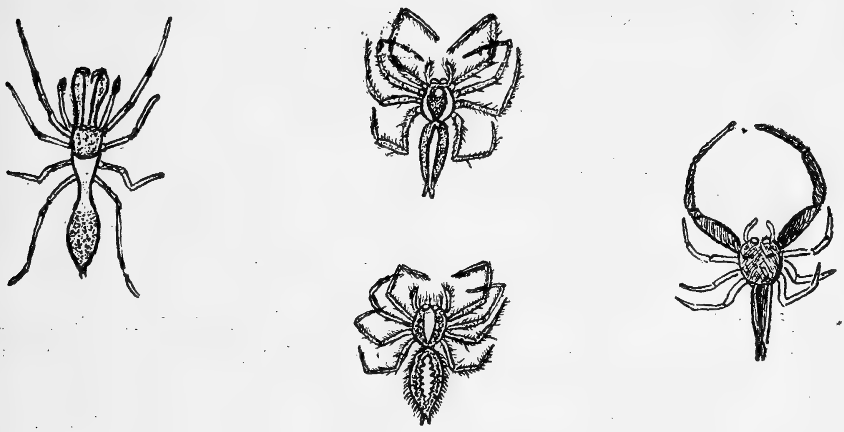

Fig. 14

Ant mimicking attid    *Plexippus* sp.    Scorpion mimicking attid

forms are protectively coloured in metallic blue or green. Some are excellent mimics. In one species the abdomen is elongate and thin and the first pair of legs enormously developed so that it resembles a miniature scorpion. The famous ant mimic spider *Myrmarachne* is included in this group. Attids can be easily recognised by the protuberant anterior median eyes directed forwards and the elevated cephalothorax.

# *Rhododendron santapaui* sp. nov. from Subansiri District, N.E.F.A., India

BY

A. R. K. Sastry [1], S. K. Kataki [2], Peter Cox, Patricia Cox, and P. Hutchison [3]

(*With two plates*)

A new species of Ericaceae, *Rhododendron santapaui*, is described from Subansiri, North East Frontier Agency.

**Rhododendron santapaui** sp. nov.

Affinis *R. kawakamii* Hayata, a quo differt forma et apice foliorum subverticillatorum ; inflorescentia 2-flora ; ovario dense lepidoto ; capsula multo longiore, lepidota.

*Frutex* epiphyticus, 0·5-1·5 m. altus ; ramuli graciles, patentes, teretes, scabridi ; rami juniores dense lepidoti, squamis albidis, circularibus c. 0·25 mm. in diam., deciduis, internodia 3-8·5 cm. longa ; cataphylla 1-2 infra folia, c. 5 mm. longa, subulata, lepidota, decidua. *Folia* subverticillata, 8-12 (15) in verticillo, subsessilia, elliptica vel elliptico-lanceolata, 2-4·5 × 0·5-2·0 cm., coriacea, ad basin attenuata, ad apicem acuta-subobtusa, breviter apiculata ; folia juniora utrinque dense lepidota ; folia matura supra nigro-viridia, rugulosa, subtus albovirentia, sparsim infra brunneo-punctato-lepidota, ad margines integra, hyalina, recurva cum sicca ; costa eminente, supra impressa, subtus porcata ; nervi laterales 3-4-jugi, supra impressi, subtus obscuri ; petioli c. 3 mm. longi. *Inflorescentia* terminalis, umbellata, 2-flora, bracteata ; bracteae plures, ciliatae, 5-8 × 3-6 mm., exteriores parvae, ovato-lanceolatae, longe aristatae, interiores magnae, deltoideae, cupulares, glumaceae, cuspidatae ; pedicelli 1-2 cm. longi, graciles, leviter arcuati, dense lepidoti. *Alabastra* albida, pyriformia, c. 12 mm. longa. *Calyx* patelliformis, 1·5 mm. longus, 2 mm. latus, extus dense lepidotus, undulate 5-dentatus, persistens. *Corolla* cereo-candida, carnosa, campanulata, 1·5-2·5 cm. lata ad os, tubo 3·5-8 mm. longo, 3-6 mm. diam., sparsim extus lepidoto, intus glabro, piloso ad faucem ; lobis 5, sparsim lepidotis extus, rotundatis vel late oblongis, 6-8 × 5-8 mm.,

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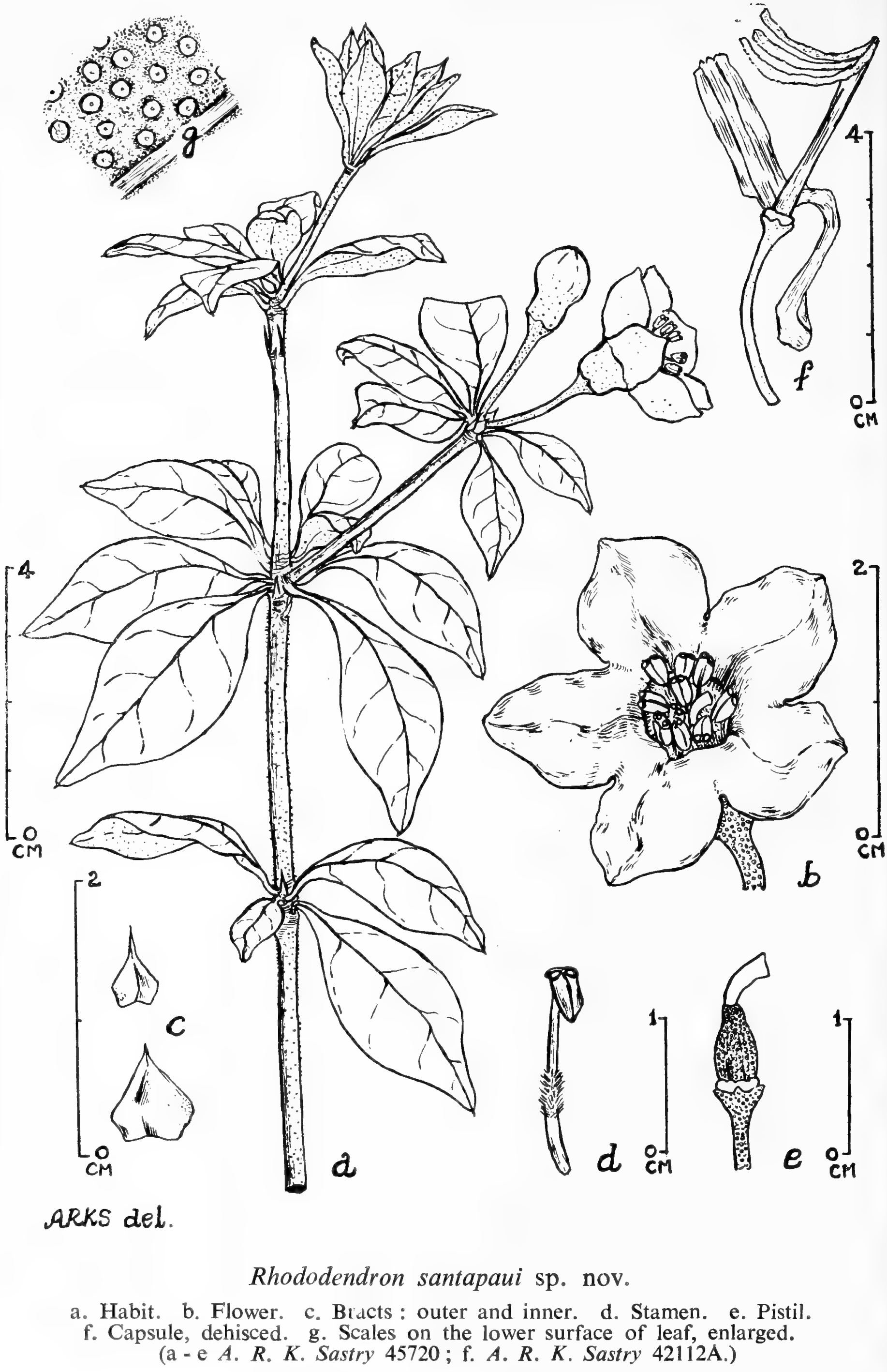
*Rhododendron santapaui* sp. nov.




*Rhododendron santapaui* sp. nov.

a. Habit. b. Flower. c. Bracts : outer and inner. d. Stamen. e. Pistil. f. Capsule, dehisced. g. Scales on the lower surface of leaf, enlarged. (a - e *A. R. K. Sastry* 45720 ; f. *A. R. K. Sastry* 42112A.)

subacutis vel obtusis, erecto-patentibus gradatim evadentibus reflexis. *Stamina* 10, subaequalia, 12 mm. longa, exserta ; filamenta albo-pubescentia ad medium ; antheris eburneis, oblongis, 2·5 mm. longis, 2-poris ad apicem, poris brunneo-annulatis. *Ovarium* ovoideum vel ovato-oblongum, 5×2·5 mm., 5-porcatum, dense lepidotum; stylo crasso, 5 mm. longo, declinato, sursum leviter ampliato, glabro ; stigmate truncato ; disco annulari, 10-lobato, glabro. *Capsula* oblonga, 3 cm. longa, gracilis, stricta, parietibus tenuibus praedita, 5-valvis, sparsim lepidota, longe pedicellata; pedicellis capsula longioribus.

Holotypus, *A. R. K. Sastry* 45720, lectus ad Begi in distr. Subansiri, ad alt. c. 1540 m. die 23 maii, 1966, positus in Herbario Nationali Centrali (CAL). Paratypi, *A. R. K. Sastry* 42112 A-C, lecti inter Saling-Hakhetari in dist. Subansiri, ad alt. *c.* 2300 m., die 21 apr. 1965, positi in Herbario Kanjilal ad Shillong (ASSAM).

**Rhododendron santapaui** sp. nov.

Allied to *R. kawakamii* Hayata, from which it differs in the shape and apex of the subverticillate leaves ; 2-flowered inflorescence ; densely scaly ovary ; much longer, scaly capsule.

Epiphytic twiggy shrub, 0·5-1·5 m. high ; twigs slender, spreading, terete, scabrid ; young shoots densely scaly ; scales white, circular, *c.* 0·25 mm. in diameter, deciduous ; internodes 3-8·5 cm. long ; cataphylls 1-2 below the leaves, *c.* 5 mm. long, subulate, scaly, deciduous. *Leaves* subverticillate, 8-12 (15) in a whorl, subsessile, elliptic or elliptic-lanceolate, 2-4·5×0·5-2·0 cm., coriaceous ; base attenuate, apex acute—subobtuse, shortly apiculate ; young leaves densely scaly on both sides ; old leaves dark green, rugulose above, pale green, sparsely brown punctate-scaly beneath ; margins entire, hyaline, recurved when dry ; midrib prominent, impressed above, ridged beneath ; lateral nerves 3-4 pairs, impressed above, obscure beneath ; petiole *c.* 3 mm. long. *Inflorescence* terminal, umbellate, 2-flowered, bracteate ; bracts many, ciliate, 5-8×3-6 mm., outer small, ovate-lanceolate, long aristate, inner large, deltoïd, cupular, glumaceous, cuspidate ; pedicels 1-2 cm. long, slender, slightly curved, densely scaly. *Flower buds* white, pyriform, *c.* 12 mm. long. *Calyx* saucer-shaped, *c.* 1·5 mm. long, *c.* 2 mm. broad, densely scaly outside, undulately 5-toothed, persistent. *Corolla* waxy-white, fleshy, campanulate, 1·5-2·5 cm. wide at mouth ; tube 3·5-8 mm. long, 3-6 mm. in diameter, sparsely scaly outside, glabrous inside, pilose at throat ; lobes 5, sparsely scaly outside, rounded or broadly oblong, subacute, or obtuse, 6-8 mm. × 5-8 mm., erect gradually becoming reflexed. *Stamens* 10, subequal, *c.* 12 mm. long, exserted ; filaments white-pubescent in the middle ; anthers creamy, oblong, *c.* 2·5 mm. long, 2-pored at apex ; pores ringed in brown.

*Ovary* ovoid or ovate-oblong, *c.* 5×2·5 mm., 5-ridged, densely scaly; style stout, *c.* 5 mm. long, declined, slightly enlarged upwards, glabrous; stigma truncate; disc annular, 10-lobed, glabrous. *Capsule* oblong, *c.* 3 cm. long, slender, straight, thin-walled, 5-celled, sparsely scaly, long pedicellate; pedicel as long as capsule.

Holotype, *A. R. K. Sastry* 45720, collected from Begi, *c.* 1540 m. alt. in Subansiri district, on 23 May, 1966, is in the Central National Herbarium (CAL). Paratypes, *A. R. K. Sastry* 42112 A-C (A & B in fruit, C in flower) collected in between Saling-Hakhetari, *c.* 2300 m. alt. in Subansiri district, on 21 April, 1965, are in the Kanjilal Herbarium, Shillong (ASSAM).

This new species is dedicated to Rev. H. Santapau, as a token of our regard and appreciation of his devoted service in the cause of taxonomic research and promotion of floristic exploration in India.

This rare epiphytic species was first collected in late fruiting stage (*Sastry* 42112 A & B, C & H 459) from Subansiri during April 1965 by a joint expedition of Botanical Survey party of A. R. K. Sastry and S. K. Kataki and the 3-member British team of Peter & Patricia Cox and P. Hutchison. The latter have noted this find in their account of the expedition in THE RHODODENDRON AND CAMELLIA YEAR BOOK (1966 : 73). A live plant (*Sastry* 42112 C) was introduced into the 'Woodlands' Compound, Botanical Survey of India, Eastern Circle, Shillong, and flowered during September, 1965. A preliminary study showed this to be a new species, allied to *R. kawakamii* Hayata from Formosa. On a subsequent exploration during May, 1966, a careful search for more plants of this species yielded just two in the vicinity of Begi, which were introduced and reared in 'Woodlands' in as near a natural habitat as possible (except for its epiphytic nature). One of these flowered during July, 1967 (45720), enabling confirmation of the earlier tentative inference of its being a novelty. In the meanwhile Mr. Peter Cox also reported in a letter that plants of this species introduced in 1965 into his garden in Glendoick, Perthshire, flowered about September, 1967.

Flowering in this plant is a protracted process, the young flower buds covered with bracts appearing in October, 1966, and ultimately flowering in July, 1967. The bracts fall off, revealing the white pear-shaped flower buds which later on open into a waxy white campanulate corolla, with the prominently ringed anthers protruding in its centre. The corolla lobes later become reflexed and after anthesis the entire corolla readily drops off. Though lacking the flamboyance of large flower trusses of other Rhododendrons, this midget shrub with its young shoots pinkish in contrast to the older dark green foliage and the geminate waxy white, starry flowers, holds promise of an elegantly ornamental Rhododendron.

ACKNOWLEDGEMENTS

We sincerely thank Prof. H. Hara, Tokyo University, for his kind and prompt supply of the type photograph and the original description of *R. kawakamii* Hayata ; Mr. R. H. Davidian, Royal Botanic Gardens, Edinburgh, for scrutiny and confirmation ; and Dr. S. K. Mukherjee, Keeper, Central National Herbarium, for preliminary comparison. We are indebted to Rev. Fr. H. Santapau, Director, Botanical Survey of India, for the Latin translation and to Dr. A. S. Rao, Regional Botanist, Shillong, for his valuable suggestions.

# Reviews

1. THE BIRD FAUNAS OF AFRICA AND ITS ISLANDS. By R. E. Moreau. pp. viii+424 (15×25 cm.), with numerous maps, tables and photographs. Academic Press, London & New York, 1966. Price 100*s*.

This is a comprehensive ecological geography of Africa based on the bird faunas inhabiting the various climatic and vegetational zones, interpreted mainly in the light of geological evidence, whose value in recent years has been so vastly enhanced by radiocarbon and other dating techniques. The author's personal experience and intimate familiarity with African birds and natural environments, and his erudition and power of incisive analyses, have combined to make the book a truly classical achievement. The multifarious factors relating to the different physical features and habitats and their characteristic bird faunas are critically analysed, the general discussion in the book resting mainly upon the composition of families and the number of species in each. It is postulated that most of the present-day genera probably already existed by the Pleiocene, but many species may have been different. The absence of bird fossils in Africa, as elsewhere, is the greatest handicap in ageing species. Though the continent has been one of the most stable land masses of the earth, vast ecological changes have evidently occurred here repeatedly within the last 20,000 years due to alternation of glacial and interglacial periods and consequent vicissitudes in climate.

The twenty chapters cover a very comprehensive range of topics: the geography and environments of Africa and past history of the continent, followed by descriptions of the bird faunas of Mediterranean and Saharan Africa, the composition and affinities of the Ethiopian as compared with extra-Ethiopian bird faunas, the montane and lowland, forest and non-forest bird faunas, etc. Two chapters—one dealing with bird migration within the Ethiopian region (chiefly controlled by the rainy season and food supply) and the other, the Immigrant Palaearctic Bird Fauna—are of special interest and fascination. The former is reminiscent of much of the local migratory movements that take place within our own area—the Indian subregion. As regards Palaearctic migration, the view formerly held that birds to and from southern Africa avoided the hazardous Sahara crossing by flying along the coasts or along the narrow corridor of the Nile Valley is fast being dispelled. There is accumulating firsthand evidence now of regular migration on

a broad front, at all longitudes, over more than a thousand miles of the inhospitable waterless Sahara desert—even by water-birds. This again is in conformity with what we are realizing in India today in the case of the High Himalayas, once postulated as an impassable barrier for central Asian migrants—thus somewhat discounting the 'river-valley route' theory which formerly held sway.

The penultimate three chapters discuss the bird faunas of Madagascar and the other east coast islands of Africa, and the subject of insular avifaunas in general. The final chapter admirably sums up the author's views and conclusions, chapter by chapter.

Moreau's contributions on African ornithology are all characterized by refreshing originality and ecological approach, by their thought-provoking and suggestive quality, and the fascinating way in which he marshalls, analyses and synthesizes his data. The present book is an epitome of these virtues, though it must be admitted that to one unfamiliar with the physiography of Africa it often makes rather heavy going! To appreciate its excellence, the help of a good physical map of Africa at the reader's elbow for ready and *constant* reference is indispensable. Numerous distribution maps of Africa interpolating forest types and various bird species, and tabulated lists analysing the presence or absence of bird families in the compared regions, help to clarify the topics discussed; the several excellent photographs, especially in Chapter 1, of typical African biotopes will bring home to the Indian reader a graphic realization of the close similarity that exists between African environments and many of his own.

S. A.

2. KHUMBU HIMAL, Volume 2: Beiträge zur Ökologie der Vögel zentral-und ost-Nepals. By Gerd Diesselhorst. With 40 black-and-white photographs and figures, and a loose folding map. pp. 420 (26×19 cm.). Universitätsverlag Wagner Ges. M.B.H., Innsbruck-München, 1968. Price DM 36.00, US $ 9.00.

There was a long hiatus in the ornithology of Nepal after Hodgson ended his two decades of classical collection in 1843 or thereabout. For nearly a century thereafter Nepal virtually remained a closed book to outsiders and only the advent of a more liberal regime permitted an upsurge of the pent-up interest in the avifauna of the country. Within the last two decades or so the birds of Nepal have enjoyed the special attention of a succession of competent investigators, among whom Mrs. Desirée Proud, Walter Koelz, Dillon Ripley, Biswamoy Biswas, and Robert L. Fleming deserve particular mention. The significant contributions on Nepal ornithology by Ripley, Fleming (jointly with

Rand and Traylor), and Biswas went a long way in bringing the post-Hodgsonian record up-to-date. The volume under review is a further addition to the basic literature on Nepal avifauna though it covers more particularly only the Sherpa province of Solu and Khumbu in NE. Nepal and the central and south-eastern parts of the kingdom.

The basis of the present report is one of the series of German scientific expeditions under the 'Research Scheme Nepal Himalaya' undertaken to study the ecology of this selected area in its widest aspects—glaciology, geography, meteorology, botany, zoology, and ethnography. The entire project, spread over a six-year period (1960 to 1965), was planned and organized by Prof. Dr Walter Hellmich of Münich (who is also the general editor of the various volumes), and sponsored by the Fritz Thyssen Foundation. The ornithological party led by Dr Gerd Diesselhorst was in the field for about nine months between February and November 1962, and collected and/or acquired some 2000 bird skins in all. The main body of the report is in German, but a useful English summary at the end gives the general background for those not too proficient in the language, and indicates the main topics dealt with—Climate, Past and Present Vegetation, Vegetational Zones, Forest Fauna, Non-Forest Fauna, Alpine Fauna, Altitudinal Distribution, Bird Populations, Breeding Seasons, Moult, and Migration : in other words the complete ecology of the birds of Nepal.

The opening chapter introduces the country and its physiography, giving reference to recent ornithological investigations, the itinerary of the Diesselhorst expedition, description of the various collecting localities, and analyses of the bird life by vegetational and altitudinal zones and on zoogeographical considerations—percentages of components of the avifauna as Palaearctic, Oriental, and so on. The systematic list which follows covers 31 families and some 361 forms. Valuable data are provided particularly on Habitats and relating to the specimens collected, such as the state of gonads and plumage, moult, and in many cases the stomach contents and weights. Therefore it seems all the greater pity that measurements have been omitted. It is not often that opportunities are vouchsafed for handling such fine series of authentically sexed specimens particularly of proved breeding birds. Measurements, it is felt, would have added very considerably to the value of the data.

Calls of birds transcribed on paper usually only accentuate the inadequacy of this method for those who have never actually heard them. Moreover, the same call rendered by a German-speaking and an English-speaking observer often tend to be so vastly different that the two versions are difficult to reconcile even for those familiar with the call. Tape-recording is of course the only answer, but how to co-ordinate tape-recordings in a meaningful way with printed text for the layman is a problem that continues to defy solution.

Among the bits of new information tucked away here and there in the text is the first definitive proof concerning the breeding biology of the Indian Honeyguide, *Indicator x. xanthonotus*, of which nothing was definitely known. A specimen collected by the author on 7 May had a mature ovary with a distended oviduct indicating that the bird had laid. An unshelled egg in the oviduct and enlarged ovarian follicles further suggested that probably five is the total number of eggs laid by the bird. The Honeyguide is believed to be brood-parasitic on barbets, but no first-hand information as regards its breeding biology in India is available.

Happily the nomenclature employed in the list is mainly that of Ripley's SYNOPSIS, our latest checklist, to which Indian ornithologists are gradually becoming acclimatized. Two notable departures are *Casmerodius* for *Egretta* in the case of the Large Egret, and *Cecropis* for *Hirundo* in that of the Redrumped Swallow. Whatever may have been considered the overriding claim of these names over the ones adopted in the SYNOPSIS and generally understood, they will certainly help to confuse the lay reader !

The report is, in many ways, a model of what such reports should be. It will stand as a very useful reference source and a welcome addition to the existing literature on Nepal ornithology. The illustrations of biotopes typical of the various altitudinal zones are purposeful and well chosen. Many of the photographs are superb, and all are excellently reproduced in the text though the art paper on which it is printed throughout makes the volume rather weighty and inconvenient to handle without a rest.

S. A.

3. FLOWERING SHRUBS. By B. P. Pal and S. Krishnamurthi. pp. xiii+155 (21×13 cm.). 41 plates, in colour and monochrome. New Delhi, 1967. Indian Council of Agricultural Research. Price Rs. 20.

FLOWERING SHRUBS, by B. P. Pal and S. Krishnamurthi, belongs to a series of books on ornamental gardening now under publication by the Indian Council of Agricultural Research. Dr. Pal, at one time Director of the Indian Agricultural Research Institute and an ornamental horticulturist by predilection, and Dr. Krishnamurthi, who retired from service as Director of Agriculture, Madras, come to the task with ample qualifications.

The authors confine themselves to enumerating a number of ornamental plants suitable for growing in Indian gardens, giving brief particulars about them, such as their origin and distribution, a general description, information about methods of propagation, hints regarding

cultivation, &c. They say nothing about gardening processes, assuming that their readers will either be acquainted with them already or have access to books dealing with the subject ; this was perhaps inevitable in a book of this size.

About 90 plants are dealt with under their specific or generic names, but numerous other species are referred to in the text, making probably more than 200 in all. Anyone wishing to put a splash of colour into his garden, therefore, has a plentiful selection of plants to choose from.

There are 41 illustrations, all but 5 of them in colour. I would have wished for many more illustrations, even if only line drawings, to indicate not only the form and nature of the inflorescence but also the shape and size of the plant itself, information that is very important when one is planning a garden. The reproduction of colour, unfortunately, leaves much to be desired.

For quick reference, Appendix I lists among other points : flower colour, season of flowering, and method of propagation. A second appendix lists the English and regional names.

D. E. R.

4. FIGS OF HONGKONG. By Dennis S. Hill. pp. viii+130 (17·5×24·5 cm.) with 178 diagrams and 65 plates. Hongkong 1967. Hongkong University Press. Price HK $60.

This is a most informative book on *Ficus* species of Hongkong and is based on data collected by the author during his entomological researches on Fig-wasps for about three years in Hongkong. Both the insects and the host trees were studied in great detail by the author from systematic and ecological stand-points. This necessitated keeping many plants under regular observation and examining many samples of figs in making the insect collection. In total, several hundred fig samples were examined from nearly two hundred different plants, during 3 year period.

It was found that each species of *Ficus* had its own species of Agaonidae in its figs. A preliminary examination of the wasps found, indicated that the vast majority were completely host specific.

This book embodies the thesis for Ph.D. degree submitted by the author. It gives the objective of the work—the systematic and ecological study of the Figs and Fig-wasps of Hongkong ; the methods used and a general account of the genus *Ficus* together with a list and key to the species of *Ficus* occurring in Hongkong. Each species and variety, following the treatment of celebrated E. J. H. Corner—an internationally renowned authority on the systematics of the genus *Ficus*, is described under the headings—habit, habitat and distribution, with the help of

excellent drawings, pie-diagrams and distribution maps. Phenological observations are given very carefully and vividly. The insects recorded or reported earlier or absence of such records are clearly indicated. Photographs of each species of *Ficus* together with comparative diagrams of fruits and leaves of all the species together at a glance, provide very useful data for identification. Synonymy given in a tabular form—not quite traditional—does serve the purpose quite adequately. Two of the chapters give synoptic reviews of Fig-wasps in general and in Hongkong in particular.

There is an extensive bibliography of 337 references covering most of the important literature of figs and fig-wasps. This is undoubtedly an ideal model for similar studies in many other regions where figs are distributed. It is of special significance to India where similar careful studies of figs can be undertaken. It is an inspiring work for those who would like to undertake studies of interdependence of plants and insects.

P. V. B.

5. HANDBOOK OF ROCK GARDENING ON THE HILLS. By P. Kachroo. pp. 90 (20×14 cm.). New Delhi, 1968. Indian Council of Agricultural Research. Price Rs. 5.20.

This book, meant for the amateur gardener, consists for the major part of a descriptive list of plants for the rock garden, preceded by ten short chapters dealing in general terms with the subject of rock gardening. [Some useful hints are given under the chapter-headings: Planting and Care.] The list is very comprehensive. A short description is given of each plant, with particular attention to the size of the plant, the time of flowering, and the nature and colour of the flowers, together with occasional gardening hints. The illustrations, in colour and monochrome and line drawings, are well chosen to give an idea of the foliage and inflorescence.

D. E. R.

6. INTRODUCTION TO AGRICULTURAL BOTANY IN INDIA. Vol. I By G. V. Chalam and J. Venkateswarlu. pp. xiv+460 (16×24 cm.) with 68 line drawings and 45 photographs. Bombay, 1965, Asia Publishing House. Price Rs. 34.

As Dr. M. S. Swaminathan in his excellent introduction to this publication states, it is but appropriate to express our gratitude to Dr. G. V. Chalam and Prof. J. Venkateswarlu for the trouble they have taken to

provide the student and the research worker a window into the fascinating world of agricultural botany. The book is blessed by the Central Minister of Agriculture in an appropriate foreword and dedicated to Dr. B. P. Pal—' the doyen of Agricultural Botany in India ' as a token of regard for his significant contributions to agricultural botany.

The first three chapters of the volume explain the process of reproduction in plants, principles of genetics with reference to plant breeding and plant breeding procedures in general. This very valuable information is explained in a simple way for all students of Botany. The remaining seven chapters deal with cereal crops like Rice, Wheat, Barley, Oats, Maize, Sorghum, Bajra, Ragi and other millet crops. Each crop is treated comprehensively dealing with morphology, anatomy, floral biology, physiology and genetics of various varieties under cultivation in India. At the end of each chapter, important references on the topics treated in the chapter are listed for research workers. The topics are very well illustrated by line drawings which are well conceived and carefully executed. The photographs are also clearly reproduced.

This volume thus presents excellent—undoubtedly the best so far—consolidated botanical account of a very important section of agricultural crops in India. Considering the importance of agriculture in our country, this publication fulfils a sorely felt lacuna. This book must be read by all students of Botany as well as by others in order to understand the complexities of the problems of crop improvement in India. Indeed this publication is the most welcome addition to the literature on agricultural botany and the authors and publishers deserve our congratulations for bringing it out.

The second volume dealing with Oil seeds, Pulses, Fibres, Spices and Tubers announced to be published in 1966 is anxiously awaited.

P. V. B.

7. SALINITY AND ARIDITY—NEW APPROACHES TO OLD PROBLEMS. Edited by H. Boyko. pp. viii+408 (17·5×24·5 cm.). Frontispiece and 37 figures. The Hague, 1966. Dr. W. Junk Publishers. Price $16.65. Dutch *Florins* 60.

This publication is the 16th Volume of MONOGRAPHIAE BIOLOGICAE published under the general editorship of P. van Oye by the same publishers.

The arid and semi-arid areas cover almost one-third of the land mass of our globe. With aridity is generally associated saline soil and saline waters, but the problem of salinity is not restricted to arid zones alone. This book embodies some experiences in productivising deserts and growing of plants by irrigation with sea water. The experiments

described in the book show that tolerance of most plant species is raised several times if the soil, is dune sand. Salt water of high concentration and in some cases even sea water can be used to productivise vast areas of shifting dunes and other sand covered areas. A few examples from the many described in this book show the possible economic and social influence of these experiments. Of interest to us in India are the results achieved with wheat and also experiments with various plants in Israel.

This book is divided in three parts. Part I—General—contains 3 articles. The first gives an introduction, a summary and an outlook on Salinity and Aridity by Dr. H. Boyko, an authority of world renown on desert ecology, who has been connected with UNESCO and other international bodies. The second article is a review of Vegetation and Salinity by V. J. Chapman, another international authority on the subject of physiology and distribution of plants of saline regions. The third article by P. C. Raheja deals with a survey of soils and land use which ends with a very optimistic picture of improving saline soils. All these articles contain very valuable lists of references.

Part II contains nine articles on principles and experimental work. The first article deals with ecological principles of plant growing by irrigation with saline water and the second with observations on plant growth under saline conditions. Six more articles in this part deal with experimental work in Israel, India and W. Germany. The last article in this part is a summary of the UNESCO-WAAS symposium held in Rome in September 1965.

Part III of the book contains a study of plant and animal life in a salt lake region in Utah, USA. This is followed by an index of plant and animal names and agricultural products.

This publication, an excellent production, leaves one with a feeling of the stupendous task that still remains to be accomplished to solve the problems of population pressures on the saline and arid land mass on the surface of our earth. One cannot help feeling that it would be more beneficial for us to direct more man-power and finance to this work rather than land some one on the moon.

P. V. B.

8. OF PREDATION AND LIFE. By Paul L. Errington. pp. xii+277 (15·5×23·5 cm.). With numerous drawings. Iowa 1967. Iowa State University Press.

The author's observations relate largely to bobwhite quail, grouse and muskrats of North Central U.S.A. which he studied over several decades, but it appears reasonable that the conclusions he reaches must apply equally to life and predation in general.

Cyclic population explosions have been recorded among snowshoe hares, grouse, muskrats, meadow mice etc. These follow periods when food is plentiful and weather conditions favourable. Similarly, severe winters affecting food supply, diseases, floods etc. seriously reduce the population. However, most species of animal life that do suffer such depletion have the resilience to recoup in numbers in a fairly short time.

The increase in population in a territory which can provide cover only for a certain number results in territorial fights and the have-nots deprived of shelter, and consequently exposed, become easy prey for predators. The effect of predation is marginal on a population that has adequate habitat.

Overcrowding leads to a rapid decline in the birthrate. Overcrowded muskrat females produced one litter in a breeding season compared to four litters under ideal conditions. Muskrats which are generally tolerant, during these population explosions become highly irritable, and even cannibalistic.

Most predators are adapted to exploit a wide variety of prey. The Horned Owl for example is not averse to taking a young fox or a cat when it has not succeeded in finding more innocuous prey and that predators have to work quite hard for a living will be evident from Gustav Rudebeck's observations in southern Sweden. For the bird-hunting European Sparrow Hawk, he recorded a total of 22 victims taken in 500 completed attacks and attempts at seizure.

The relative scarcity of predators is illustrated by a study made in an area of southern Michigan which showed ninety-six hawks of six species and sixty-three owls of four species that had below them in the 'Pyramid of numbers' about 360,000 small to medium sized mammals and birds.

Through in-built population control mechanisms and predation, nature maintains a balance. This balance is upset when there is human interference leading to the destruction of cover resulting in the exposure and consequent extermination of various species of birds and mammals.

Sentimental animosity to certain predators, like for example wolves which play an important role in controlling the Caribou population in northern America, has led to their mass destruction by employing aircraft to drop poisoned bait in remote areas. Golden Eagles, although legally protected are nevertheless subject to persecution even in Scandinavia where people are so conservation-minded. No predator is so numerous as to be a menace to justify such senseless persecution. Fanciful ideas of transferring species to regions where they are exotic have in many instances been harmful to the native species.

An interesting opinion that the author expresses concerns his doubt whether biological control on a large scale will be as successful as it is convincingly shown to be in some controlled experiments.

Dr. Errington quite rightly deprecates the tendency to justify the existence of this or that species solely on economic grounds and feels that it is a public responsibility to safeguard what can be saved of wilderness areas before the great push of humanity.

This informative book would have been more readable if the statistics in it, of which there is a fair amount, could have been presented in tabular form instead of being narrated which makes it somewhat soporific. The pen ink illustrations are quite attractive.

G. S. R.

9. THE TERRITORIAL IMPERATIVE. By Robert Ardrey. pp. 390. Delta book (paper back) TM 755118. New York, 1968. Dell Co., Inc. Price $ 2.45.

Mr. Ardrey's first career was writing plays. Later he was sent to Africa to write a series of magazine articles and while there became interested in discoveries made by anthropologists on the early evolution of man and his ancestors. The result was his first book, AFRICAN GENESIS, in which he drew not only from information gathered by anthropologists studying fossils, but also by zoologists studying live animals. His interest continued and deepened and resulted in the publication of THE TERRITORIAL IMPERATIVE which bears the subtitle *A Personal inquiry into the Animal Origins of Property and Nations.*

He has read a great many books and papers dealing with animal behaviour and attempts to put this information together in a way which demonstrates his thesis on the origin of property and nations. It has been said by some reviewers that he has an economic or political axe to grind. That is so. It is also true that at times he allows his strong feelings on the subjects to mar the objectivity and continuity of his argument. And occasionally he becomes overwhelmed by his sense of the dramatic, or the humorous, and loses the sympathy of the critical reader.

But the book should not be dismissed merely because of these faults. His ideas are interesting and provocative.

His thesis is this: Man's behaviour, since he is an animal, is basically that of other animals (this idea is not far from that of Sigmund Freud, although he reached different conclusions). Further, Ardrey continues, one of the basic behavioural traits of most higher species is territorialism and this trait is shared by man. Territorial animals defend an area against intrusion by members of the same species. The size of the territory, the duration of its defence, and the number of individuals involved in the defence vary greatly from species to species. The male Uganda Kob, for instance, defends only a small area of a few hundred square feet, and that only during rut. Some primates, such as the howler monkeys, live

in bands which occupy and defend larger areas on a more or less permanent basis.

The Darwinian idea of males competing with other males for mates has been modified (as discussed by Wynne-Edwards in his ANIMAL DISPERSION IN RELATION TO SOCIAL BEHAVIOUR). It is now generally recognized that males, be they Uganda Kob or robins, are competing for a territory, a space which contains, or will contain, a female, or as Ardrey puts it, they are competing for real estate.

Ardrey sees man's territorialism expressed on the individual level (' my house ', ' my farm,' ' my coat '), on the family or group level, and finally on the national level. Modern nations have their counter part in some species of primates.

Along with man's innate territorialism he discusses man's equally innate tendency to intrude upon his neighbour's territories, the biological basis of war. Like several other people who have thought about the subject, Ardrey believes that if a trait is innate, or instinctive, we cannot rid ourselves of it. The only hope is to offer alternative outlets for man's aggressive tendencies. He calls for the ritualization of war so that it becomes harmless.

Even the most vociferous critics of Ardrey will admit that there are, if nothing else, parallels between the behaviour of other animals and man regarding territory. The real question is, of course, is man actually territorial? Ardrey is convinced that he is and he has, I believe, voiced an opinion, no matter how shaky his logic might be at times, which has been held nebulously and silently by many ethologists for the last decade or so. When I look at the jealousy with which I guard my desk, my home, my family, my nation, I suspect man is territorial. Perhaps Ardrey's book will help to stimulate more intensive examinations of the question.

D. W. P.

10. TRACKS. By E. A. R. Ennion and N. Tinbergen. pp. 63 (28×21 cm.). With numerous photographs and drawings. Oxford, 1967. Oxford University Press. Price 25*s*. net, U.K.

The title TRACKS, in its brevity and clarity, is in keeping with the brevity and clarity of the text that accompanies the beautiful photographs of Professor Tinbergen and the delightful coloured drawings of Dr. Ennion that help to make them more readily intelligible. A foretaste of the feast in store is given by the natterjack toad painfully scrawling his picturesque trail across the dust cover.

One cannot watch animals—I use the term in its widest sense—all the time and in all places. This book shows how much one can learn of

their doings and of their ways by merely studying the little traces they leave behind them in their movements, in the day and particularly during the night.

Less than 30 words suffice to give meaning to a trail across a wind-rippled sandflat and help us to picture exactly how it was formed by a gait we all know, a rabbit hopping slowly along. About 40 words, aided by a coloured drawing, bring to life the track of a rabbit moving quietly forward and scared away by a sudden alarm. A similar track left by an oystercatcher on wind-rippled sand indicates a change of direction of the wind since the ripples were formed. Sometimes the drawing alone suffices and words are unnecessary (pages 24 and 25).

This is a book that should be in the hands of *all* young persons, to rouse their interest in nature and, if they are already interested, to guide them towards intelligent observation. And it should be carefully perused by every grown-up also.

D. E. R.

11. MIMICRY IN PLANTS AND ANIMALS. By Wolfgang Wickler. Translated from the German by R. D. Martin. World University Library pp. 153 (19×12 cm). With 52 illustrations. London, 1968. Weidenfeld and Nicolson. Paperback. Price (in UK only) 16 *s* net.

Since Henry Bates in 1862 first formulated his ideas on the phenomenon of mimicry, the concept of mimicry has been much developed. In addition to Batesian mimicry, the mimicking of a protected by an unprotected form of life, we now speak of Müllerian mimicry where two or more protected forms resemble one another, Mertensian mimicry in which a deadly form mimics a less dangerous form, and aggressive or Peckhammian mimicry. Or mimicry may be of an unprotected form, for example certain trematode larvae mimic a water-flea in order to be swallowed by a fish and so continue their cycle of life. In another form of mimicry the male of an African Cichlid fish, by means of a pattern of eggs on its anal fin, induces the female to swallow water in which he has spawned and so to fertilise unfertilised eggs which she has already taken into her mouth for brooding. The subject is vast and full of complications and overlapping. The signals by which deception is effected may be of various kinds, visual, acoustic, tactile, behavioural. Mimicking may even be by a group, for example a group of Fulgorid bugs mimics an inflorescence, or a collection of marine worms a sea-anemone. In a mimicking species the males may be non-mimetic and at the same time the mimetic females may be polymorphic and modelled upon more than one protected species. Several signal transmitters may mimic a com-

mon model or models, the mimicry being Batesian at one end and Peckhammian at the other. Several signal receivers may be involved, each responding to a different signal or combination of signals. Often it is difficult to decide which is the signal receiver concerned, and to determine which of the signal transmitters is the model and which the mimic. These are only some of the possibilities. Hence, it is difficult to establish the theory by rigid proof and mimicry is still a matter of controversy. The subject, together with the allied phenomenon of camouflage or cryptic colouring, is discussed by the author in all its complexity, and the manner in which the phenomenon may have evolved is considered. Numerous illustrative and instructive examples are cited and an account is given of the research done towards establishing the theory. The book is tough reading for the layman but is intensely rewarding. The text is accompanied by numerous good illustrations.

D. E. R.

12. GALAPAGOS. ISLANDS OF BIRDS. By Bryan Nelson. pp. xx+338 (23×15 cm.). 57 Photographs in 24 plates, a map and numerous text-figures. London, 1968. Longmans, Green and Co. Ltd. Price 50*s*.

A trained birdwatcher can spend his time usefully anywhere. The seemingly unco-ordinated movements of flocks of sea birds wheeling over the ocean, or the peculiar postures adopted by individuals when they settle on land are all pointers which lead him along the road of discovery. He does not know in the beginning, whether the data he is collecting can be assembled into an integrated essay at the end of his study, or whether it will be an unconnected series of observations. The more perspicacious the observer, the less his observations will be wasted, and everything he sees will become grist to the mill of his keen mind. This is the feeling one gets while reading this entertaining and scientifically written account of the birds of the Galapagos islands. Eighteen months of arduous work on a waterless island could only be sustained if the author knew that he was doing something valuable, and adding substantially to the existing knowledge of world ornithologists.

Many naturalists would be incapable of doing the work they do unless they were both emotionally and physically supported by their wives during their expeditions, and Bryan Nelson acknowledges that without the aid of a wife who was 'field assistant, cook, secretary, companion and critic' he could not have continued his work for so long on an uninhabited, waterless Galapagos Island. So dry is this place, surrounded by the oceans, that mocking birds were very often seen pecking at the cloaca of boobies, and blood drinking by these

passerines showed how short they were of liquids. The plight of the ornithologist couple can be imagined.

The Sulidae, gannets and boobies, are a family belonging to a large order Pelecaniformes (Pelicans, boobies, gannets, cormorants, darters, tropic birds, frigates). This book deals mainly with the redfooted, white, bluefooted and Peruvian boobies, but there are most interesting accounts of other birds like albatrosses, gulls, mocking birds as well. The author's erudition sits lightly upon him, but his easy style cannot entirely conceal the arduous grind which these studies must have involved. Banding, weighing, measuring, recording hundreds of nestlings before breakfast every morning, waiting for hours on end to see how often the nestlings are fed and handling unpleasantly oily gannet nestlings, can become unbearable chores after the initial excitement of the first few days are over. The author's capacity to sketch as ably as he writes is a great asset. Many situations which can be conveyed to the reader by a sketch cannot adequately be expressed in words : for example ' A male red-foot momentarily aggressive to the female, eliciting slight withdrawal ', ' Blue-foots mutual sky pointing ' ; ' frigate up-ending a white booby '. A few strokes of the pencil give an excellent representation of a Galapogos hawk carrying off a Darwin finch, while a dozen sketches, of the waved albatross and white boobies, and swallow-tailed gulls reveal their courtship patterns and threat postures in just one double page each. These sketches make the book lively and interesting in a way which the fine writing alone could not have done, and this again goes to show how many qualities a naturalist must have before he can produce a really worthwhile book.

The most interesting part of a book of this nature, at least to this reviewer, are the generalisations, the formulating of ecological principles, the determining of the relationship between birds and their specific environments. Why has the Redfooted Booby for instance, evolved into an arboreal bird in spite of its webbed feet? Was it because of its short tarsi which makes it easier for it to hop on branches rather than progress on the ground? What is the advantage of whiteness to a sea bird? Apparently it is less visible to fish than a dark form, but then why have dark forms survived at all, and are the dark forms predominantly nocturnal or crepuscular in their hunting habits?

Being surrounded by vast numbers of gannets and boobies the author had an excellent opportunity to see the differences in their habits, and to find out which of these species were better adapted to their harsh environment. In spite of the so called abundance of the seas there were days when a young booby had to wait five days before its parents returned from their foraging expeditions (This incidentally means that the author/wife had to keep between them a round-the clock vigil for 5 days to see what was happening.) The death rate is absurdly high and in one case

92% of the eggs failed to produce an adult bird. The author suggests that the lack of food is responsible for nature's harsh scheme of keeping only so many birds alive in any particular area.

Bryan Nelson has set a standard of ornithological writing which not many will be able to achieve.

Z. F.

13. PESTICIDES AND POLLUTION. By Kenneth Mellanby. pp. 221 (22×15 cm.) 14 illustrations. London, 1967. Collins. Price 30*s* net.

The problem of pollution of the air, water and land has received, as it should, increasing attention during the last decade. Rachel Carson, apparently, overstated the case against synthetic chemicals, but there is no room at all for complacency, and in arriving at a balanced view, this book, written by the Director, of the Nature Conservancy's, Monks-wood Experimental Station, will play a valuable part.

It is cheering to learn that the Oxygen content of the air is so high that smoke, dust and overcrowding cannot lead to serious consequences for the human race. The housewife will be driven to desperation by soot blackening curtains and furniture, and white sheep will become black around smoke infested industrial zones, but the damage does not go any deeper than this. The 2111 recording instruments spread over Britain indicate that in heavily industrialised areas about 2 lbs. of grit and dust fall on every square yard. In rural areas the figure may be less than a tenth of an ounce. Sulphur dioxide produced by burning oil is more of a health hazard, but the worst offender is the 3000 tons of lead emitted with the exhaust gas of cars in Britain.

Carbon dioxide is another gas which can cause serious damage. At the present rate of burning of 'fossil fuels' the $Co_2$ content of the atmosphere may be raised by 25%, and this may have the catastrophic consequence of melting the polar ice cap and submerging a great part of the land surface of the world. Not enough is yet known, however, about this factor, to justify an alarmist view. An interesting side effect of pollution of the atmosphere by man is the evolution of melanic races of moths which are adapting themselves to their new dark environments. The Peppered Moth (*Bison betularie*) is a case in point.

As far as wild life is concerned, generally, man has to be more careful with keeping the water from contamination for the quantity of oxygen in water is much less than in the air, and any damage has deleterious effects on all aquatic forms.

Though atomic radiation is a factor which has caused the greatest concern to the human race in recent years, it appears from what the

author writes that the present quantities of radio-active pollution is on a very small scale compared even to the intensity of solar radiation. In terms of *rads* the total radiation from cosmic rays, from rocks, and from within the body amounts to about 0·1000, while the radiation from atomic explosions and waste disposal amounts to only ·0016.

The author discusses in a very convincing manner the effects of pesticides and insecticides on various forms of wild life, and on the environment in general, and pleads for more scientific research as well as for more positive action by all citizens to arrest the growing pollution of our environment.

Z. F.

# Miscellaneous Notes

## 1. TAXONOMIC STATUS OF *ROUSETTUS SEMINUDUS* (GRAY): (CHIROPTERA: PTEROPIDAE)

### Introduction

The Indian Fulvous Fruit Bat, *Rousettus leschenaulti* (Desmarest, 1820) and the Ceylon Fruit Bat, *R. seminudus* (Gray, 1870) are very difficult to separate. Jerdon (1874), Dobson (1876) and Blanford (1891) considered them as conspecific. On the other hand, Andersen (1912), Wroughton (1918), Tate (1943) and Ellerman & Morrison-Scott (1951) treated them as separate species. Recently, Brosset (1962, p. 10) was uncertain of their correct taxonomic status and wrote, in reference to *R. leschenaulti*, 'conspecific with *Rousettus seminudus*.'

In an attempt to settle the taxonomic status of *R. seminudus*, I made a thorough study of all the specimens of these two species available in the Zoological Survey of India and my findings are presented below.

### Material

The following material was examined:—

*Rousettus leschenaulti:* 9 ♂♂, 7 ♀♀ (preserved in spirit) and 8 ♂♂, 6 ♀♀ (skins from India and Burma.

*Rousettus seminudus:* 1 ♂, 2 ♀♀ (preserved in spirit) and 1 ♂, 13 ♀♀ (skins) from Ceylon.

### Observations

*Rousettus leschenaulti* and *R. seminudus* are said to differ from each other on coloration, amount of fur on the nape and shoulders, length of the forearm and the presence or absence of the upper first premolar.

*Coloration:*

According to Gray (1870), in *R. seminudus* the coloration of the upper side is chestnut brown (grey brown of *R. leschenaulti*), and

that of the upper chest white, lower chest and belly pale brown (fulvous ashy of *R. leschenaulti*).

In the dry skins of both species, however, the coloration of the upper side varies from yellowish brown to dark brown and that of the underside wood brown. As the coloration observed by the earlier authors and myself do not agree with one another, it seems that this variation may be individual or due to sex, age, season, age of skin, etc.

*Amount of fur on the nape and shoulders:*

Andersen (1912) stated that the nape and shoulders are semi-naked in *R. seminudus*, but in *R. leschenaulti* the fur in these regions is not unusually scarce.

An examination of my specimens reveals that the amount of fur on the nape and shoulders is variable, and that semi-naked nape and shoulders are found in specimens of both species.

*Length of the forearm:*

The length of the forearm in *R. seminudus* has been given as 79-85 mm., and that of *R. leschenaulti* 80·5-87·5 mm. (Andersen 1912). However, as may be seen from the measurements given by Andersen (1912) and those of my specimens (Table), there is complete overlap in the length of the forearm of the two species.

**The Table** also shows that there is no difference in the measurements of other external characters of the two species.

*Upper first premolar:*

Andersen (1912) found that the upper first premolar was present in the adult of *R. leschenaulti* but absent in that of *R. seminudus*. Although Wroughton (1918) did not say anything about this tooth in *R. seminudus*, Phillip (1935) found it present in his specimens of this species. From an examination of my specimens, however, I find that this tooth is present in all my examples of both the species except in one of *R. seminudus* (Z.S.I. Reg. No. 16684, ♀, Kandy, C. P., Ceylon) and one of *R. leschenaulti* (Z. S. I. Reg. No. 17952, ♂, Kumaon, U. P., India).

Furthermore, the shape and size of the skulls of the two do not differ and their cranial measurements (Table) are exceedingly close.

From the above observations it is clear that there is no character by which the two species can be separated from each other. *Rousettus seminudus* (Gray 1870) should, therefore, be considered a synonym of *R. leschenaulti* (Desmarest 1820).

## TABLE

### EXTERNAL MEASUREMENTS (in mm.)

*Rousettus leschenaulti* (Desmarest)

| | Ear | Forearm | Pollex | 2nd digit | Tibia | Foot and claw |
|---|---|---|---|---|---|---|
| 4♂♂ | 19, 19, 20, 21 | 75, 83, 85, 86 | 22, 22, 23, 25·5 | 47, 52, 52, 53 | 34, 40, 41, 41 | 18·5, 19, 20, 21·5 |
| 3♀♀ | 18, 18·5, 19 | 72, 80, 86 | 21, 22·2, 27 | 47, 51, 53 | 36, 37·5, 41 | 18·5, 19·5, 20 |

*Rousettus seminudus* (Gray)

| | Ear | Forearm | Pollex | 2nd digit | Tibia | Foot and claw |
|---|---|---|---|---|---|---|
| 1♂ | 20 | 76 | 24 | 49 | 34 | 22 |
| 3♀♀ | 19, 20, 21 | 72·5, 75, 83 | 20, 20 | 44, 47 | 34, 38 | 18, 18, 20 |

### CRANIAL MEASUREMENTS (in mm.)

*Rousettus leschenaulti* (Desmarest)

| | Total length | Condylo-basal length | Zygomatic width | Cranial width | Maxillary width | Palatal length | Inter orbital width | Upper tooth row | Lower tooth row | Mandibular length |
|---|---|---|---|---|---|---|---|---|---|---|
| 3♂♂ | 36, 39, 40 | 34, 38, 38 | 20·5, 23, 24 | 15, 16, 16 | 10·5, 12, 12 | 19, 21, 22 | 8, 8·5, 9 | 13, 14·5, 15 | 15, 15, 17 | 28, 30, 30·5 |
| 2♀♀ | 37·5, 38 | 36, 36 | 21·5, 22 | 15, 15 | 11, 11 | 20, 21 | 8, 8·2 | 14, 14.5 | 15, 16 | 29, 29 |

*Rousettus seminudus* (Gray)

| | Total length | Condylo-basal length | Zygomatic width | Cranial width | Maxillary width | Palatal length | Inter orbital width | Upper tooth row | Lower tooth row | Mandibular length |
|---|---|---|---|---|---|---|---|---|---|---|
| 1♂ | 39 | 37 | 22 | 15·5 | 11 | 21·5 | 9 | 14 | 15.6 | 29·7 |
| 3♀♀ | 37, 38, 38·5 | 36, 36·1, 37·5 | 22, 23, 23·5 | 15·5, 15·8, 16 | 11, 11, 12 | 19, 20, 21 | 8·4, 9·9 | 13·6, 14, 14·5 | 14·5, 15, 16 | 28, 29, 29 |

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8, LINDSAY STREET, CALCUTTA-16,
*November* 20, 1967.

Y. P. SINHA

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## 2. NOTES ON BARKING DEER, *MUNTIACUS MUNTJAK* (ZIMMERMANN)

In the July-August issue (1967) of *Hornbill* Newsletter some comments on the coloration of newly born barking deer aroused my interest and brought back to mind some observations of nearly fifty years ago! In the distant past I frequently observed and collected barking deer in several parts of India and frequently kept them as pets.

In the Western Ghats my observation go back many years, in the Naga Hills, Assam and Northern Burma (Chindwin Expedition, 1935), the base of the Himalayas and in some areas of southern India my observations were more restricted in time.

Normally, the Muntjac is a solitary animal for the greater part of the year, both by day and by night, but the sexes come together for a short interval during the breeding season. I have seen family

parties composed of a pair of adults with one, rarely two, young (one young at a birth appears to be more normal) moving round together. While in Burma in 1935 I shot a specimen in January (1935) at Nanyasaik which, I discovered later, contained a well advanced foetus. A couple of days later I secured a fine male with excellent antlers for Burma—I believe, just short of the record head. At the time I was sitting under a fruiting Banyan Tree (*Ficus bengalensis*) waiting for specimen to 'turn up', this method I always found the most profitable when collecting specimens whether mammals or birds when time was available instead of crashing through the jungle.

Barking Deer appear to be more crepuscular or even nocturnal in their habits, seldom moving round during the day unless disturbed. When on the prowl, for specimen at night with a powerful electric headlight, I have frequently put them up in the beam of the torch, their eyes glowing like large rubies. For a time they would stare, inquisitively, trying to discover the source of light, then, with a sudden loud bark dash away—warning the whole neighbourhood. On occasion the animals would just slink away noiselessly and vanish into the darkness. In addition to the well-known bark Muntjac produce a faint, but distinct whistle, like some other deer do; lastly, there is the controversial 'clicking' sound which some observers suggest is produced by the canine teeth; my own belief is that this last sound is made by the tongue on the palate for I have heard it made by captive animals when I have been quite near, the jaws were not moved at the time the sound was uttered, however, the point still needs further investigation and observation.

I have had many young Muntjac brought to me by villagers and also caught by the 'Kathkaris' when out with them hunting—young of all ages, but never have I seen spotted young. The large foetus obtained during the Chindwin Expedition is probably available and could be examined. Young deer and antelope are frequently very difficult to determine and could, at times, be easily confused, particularly when secured in the absence of the adults.

Spotting, as is well-known, is a disruptive colouring and occurs under varied conditions in adults or young (or both) of many species which inhabit the spangled light of open jungle or dense grass country. The behaviour of animals displaying such patterns is generally in keeping with their colouring—'sudden freezing' when alarmed. However, camouflage is a complex subject and I do not propose to discuss it at length here—it is best understood by those who have experienced it and understood the biotics of the animals so protected.

However, it must be remembered that the Muntjac and the Four-horned antelope (*Tetraceros*) frequently border one another's terrain

and the identity of the young presents a problem. Likewise the muntjac and chital frequently become close neighbours and here again the uninitiated could frequently confuse the young in the absence of the parents.

The Muntjac also inhabits the same terrain as the Sambar (*Cervus unicolor*): in both these animals, as far as my own experience goes the newly born are not spotted. However, the young of these two could not possibly be confused because of size and texture of hair. Spotting in dense forest dwellers would tend to endanger the young and expose them more readily to predators. Without labouring the subject any further, I believe that the newly born young of the Muntjac are *unspotted.* I have not observed anything to the contrary. The photograph of two young taken at Khandala, W. Ghats in May of 1918 supports my view the young are immaculate at birth in the W. Ghats.

8, Kiwi Street,
Heretaunga,
New Zealand,
*March* 20, 1968.

CHARLES McCANN

## 3. THE NILGIRI TAHR, *HEMITRAGUS HYLOCRIUS* OGILBY

(*With two plates*)

The Nilgiri Tahr is found in the high hill ranges of south India, the main area being the Nilgiris, Anaimalais, and the Western Ghats south to Cape Comorin, at elevations of 4,000-8,000 feet. In the Nilgiris they are now more or less confined to the south-west edge of the Kundahs from Sispara Pass along the edge of the escarpment north to Mukurti and Nilgiri Peaks.

Here an almost sheer cliff drops 2,000-3,000 feet down from the plateau of rolling grass covered hills to the thick jungle clad valleys below. In the early morning small herds of Tahr numbering anything up to twenty, may be found grazing on the grassy slopes at the edge of the escarpment, and if left undisturbed may lie up on these hills throughout the day and continue feeding again in the late afternoon. However, if they are disturbed they will quickly move over the edge of the escarpment, scrambling and leaping down the steep gullies to lie up on some sheltered ledge below. In areas where

there is continued disturbance it is rare to find them lying on the high ground during the day. These herds consist of young males, females and kids of all ages as there is no set breeding period, the kids being dropped throughout the year. The old 'Saddlebacks' are solitary animals, preferring to feed and lie-up on their own away from the main herds, particularly during the hot season.

The exact status of the Tahr is somewhat uncertain. In 1963 the Nilgiri Wild Life Association carried out a survey in the Nilgiris and arrived at an estimate of 400 animals, and since that time they believe they have at least held their own, and that there might have been a slight increase in numbers. A rough estimate of just over 4000 has also been made for the other areas of this range. These figures may be inaccurate, and it seems essential that an up-to-date census should be undertaken to establish their true status so that appropriate action can be taken to ensure their survival.

At the present time they are reasonably safe in certain areas of their range in the Nilgiri Hills. Approach from the south and west is practically impossible due to the steep escarpment with its thick jungle clad lower slopes, whilst from the plateau itself a four to five hour walk keeps out those who like to poach from car or jeep, and so there is little poaching in these areas. The few 'Saddlebacks' taken out under licence by sportsmen have little impact on the herds, and their reports on what they see are of great value to the Nilgiri Wild Life Association. Unfortunately this state of affairs is not likely to last long. In the last few years dams have been erected in the Nilgiris for irrigation and hydro-electric schemes. New villages created for the construction gangs and their families remain in spite of the work having been completed. A policy of afforestation of the hills with wattle and eucalyptus is altering the habitat, and far worse, forest roads are being extended nearer and nearer tahr areas.

In one area I visited, planting had reached the edge of the escarpment, spoiling the tahr feeding grounds. Whilst on our way we passed over one hundred people constructing a road to within half-a-mile of this area where temporary hutments had been erected. The only hope for the survival of tahr in these areas is to persuade the State Government and Forest Department to leave a belt of grassland along the edge of the escarpment and to keep the areas as inaccessible as possible.

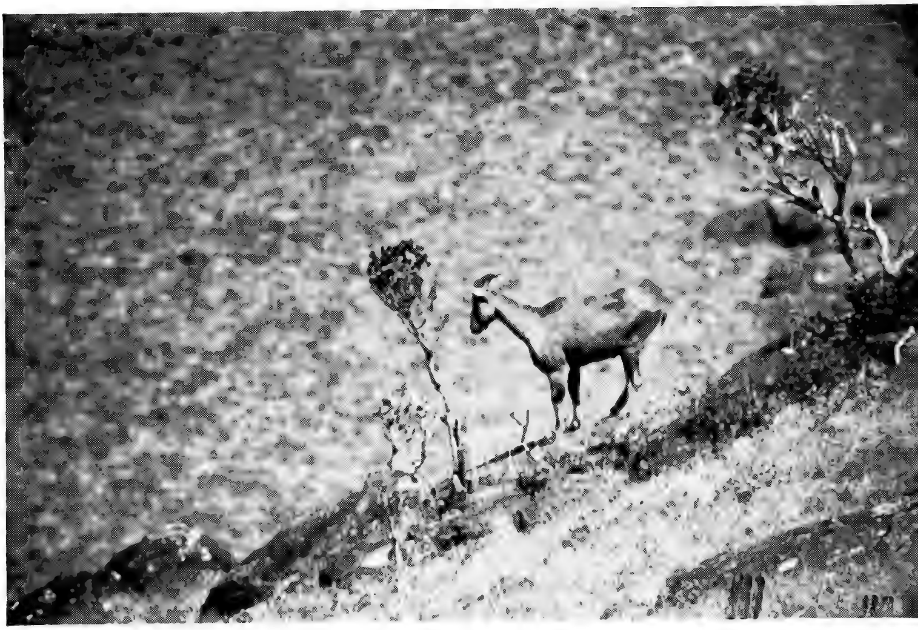
For us to see the tahr to their best advantage in January 1968, arrangements had been made to camp in one of the more remote tahr areas. We drove out from Ootacamund, passing Emerald Lake and on to Avalanche, where a further lake has recently been dammed,

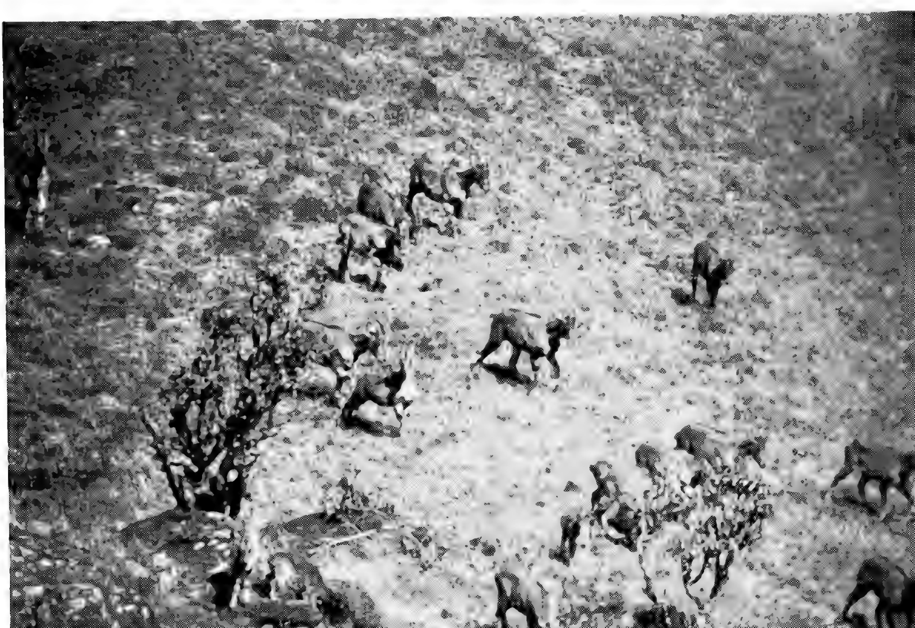
Willett : Nilgiri Tahr

*Above :* Shola Forests below Tahr habitat ; *Below :* Typical Tahr country.

(*Photos : J. A. Willett*)

Willett : Nilgiri Tahr





*Above :* A tahr 'sentinel'; *Below :* A herd on the grazing grounds.
(*Photos : J. A. Willett*)

the surrounding countryside either being under cultivation or planted-up with wattle. Soon we came to the end of the track where we were met by our Shikari 'Old Joe' and his helpers. Loading our equipment on their heads we moved off in single file down a narrow track and soon left the wattle behind. The country consisted of grass covered rolling hills, with dense woods running up the steeper and more sheltered valleys. These sholas afford cover for the black Nilgiri langur, sambar and muntjac. At one point we found some old pug marks of a tiger, and were told by 'Old Joe' that one had been seen in the area about ten days previously though they are now comparatively rare. After a three hours walk, camp was pitched in the lea of a shola and some trout were caught and cooked for supper. As we set off in the cool of the dawn a reddish tinge in the sky was soon giving way to brighter light, and by the time we reached the edge of the escarpment the tops of the hills seemed ablaze in the first red rays of the morning sun whilst three thousand feet below the jungle was still hidden in mists. We spotted our first tahr grazing near the edge of the cliff and as he had sighted us he soon moved off out of sight. After a stiff climb we located a herd of fourteen dozing in the sun, whilst three hundred yards beyond another group was still grazing. Eventually they moved up and lay down with the others. There were no 'Saddlebacks' present, though there were several younger bucks, and does with kids of varying ages.

On a rock overlooking the abyss below an old doe was acting as sentinel always alert for any approaching danger. After a couple of hours they got up and started grazing again, and whilst some of the younger kids playfully chased each other round a rock, two older bucks sparred together, gently butting their heads, and then suddenly rearing up to strike out at each other with their forelegs.

Gradually the herd drifted past us and disappeared from view over the edge of the escarpment. Moving down to get another view of them I must have been winded by them as suddenly they dashed past only twenty yards away, leaping on to a rock and away up the hill as hard as they could go. It was a wonderful experience to see them so close, and to visit such glorious country before it is completely ruined by advancing civilization.

MANOR FARM,
BISHOPSTONE, JOHN WILLET
SEAFORD, SUSSEX,
*October* 21, 1968.

## 4. THE GREAT INDIAN RORQUAL *BALAENOPTERA MUSCULUS* (LINN.) NEAR PASNI (MEKRAN COAST), WEST PAKISTAN

A specimen of Great Indian Rorqual was stranded about 5 miles west of Pasni in June, 1967. The scattered bones of the skeleton (a few missing) were brought to Karachi by the staff of the Zoological Survey Department in their Launch *Talash* from Pasni with the assistance of the Provincial Fisheries Department staff stationed at Pasni. The skeleton is being articulated (the missing bones being made and fitted) and will be put for display in the Natural History Museum of the Department at Karachi.

The various measurements of the skeleton are as follows:—

| | |
|---|---|
| Length of entire skeleton | .. 60′ |
| Length of skull without maxilla and mandible | .. 7′ |
| Length across Zygomatic arch | .. 9′·4″ |
| Length of ramus of lower jaw | .. 18′ |
| Radius of ramus | .. 3′·4″ |
| Length of coronoid process | .. 1′·2″ |
| Length of Rib—(maximum) | .. 10′ |
| No. of Ribs | .. 15 |
| No. of vertebrae | .. 57 |

*Previous records from West Pakistan:*

Murray [1] had indicated that a skull (17′·8″ in length and 7′ across Zygomatic arch) of the Indian Rorqual was stranded on Clifton beach in 1879.

In 1965, through the courtesy of the Provincial Fisheries Department at Pasni, the Zoological Survey Department was able to collect some pieces of skeleton of an Indian Rorqual from Juddi (near Pasni), Mekran Coast. The length of ramus of lower jaw is 10′

ACKNOWLEDGEMENTS

I would like to express my sincere thanks to Mr. Zahid Hussain, Deputy Director of Fisheries, West Pakistan, Pasni, and other staff of the Provincial Fisheries Department as well as the officers, staff and crew of the Zoological Survey Department for their co-operation and assistance rendered in several ways.

DIRECTOR,
ZOOLOGICAL SURVEY DEPARTMENT, M. S. U. SIDDIQI
GOVERNMENT OF PAKISTAN,
KARACHI,
*September* 20, 1968.

[1] Murray, J. A. (1884): The Vertebrate Zoology of Sind, P. 41.

## 5. REDNECKED GREBE *PODICEPS GRISEIGENA* (BODDAERT) AGAIN SIGHTED IN WEST PAKISTAN

With reference to our sighting of the Rednecked Grebe (1967), it is interesting to record that two birds of this species were sighted on Nammal Lake in the Punjab Salt Range on September 24, 1967. They were studied at a hundred yards range through a powerful telescope. One was in almost full summer plumage while the other was half into winter plumage though still having white cheeks and throat.

It is interesting to note that this species was first recorded in Afghanistan on September 17, 1966 (one bird in summer plumage) at Kargah Lake near Kabul (Niethammer 1967). Also two grebes in winter plumage believed to be of this species had been seen at the same place on February 10, 1966 (loc. cit.).

WILDFOWL SURVEY,
11-F GULBERG,
POST BAG 704,
LAHORE, WEST PAKISTAN,
*March* 8, 1968.

C. D. W. SAVAGE

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## 6. COTTON TEAL *NETTAPUS COROMANDELIANUS* (GMELIN) AND WATER SNAKE

On January 4, 1968, at about 5 p.m. in the evening I visited the village pond at Kihim (Taluka Alibag, Kolaba District). It is a comparatively small pond, circular in shape, with a diameter of perhaps a hundred yards. It contains some weeds all round and a great many white water-lilies. There was a variety of bird life on it, including a couple of jacanas, dabchicks, coots and a few sandpipers. There were also 5 or 6 whistlers and 4 cotton teals.

Watching the cotton teal, I found them playing about with something that swam in the water. Using my binoculars (Zeiss, Deltrintem, 8 by 30), I saw a water snake swimming round to each one of them, and as they ducked or swam away, he went to the others in turn. He made almost a full circle and then disappeared.

I wonder if any of your readers has observed wildfowl playing about with water snakes in this fashion; and whether they fraternize with any living things other than their own species.

BOMBAY, A. A. A. FYZEE
*January* 24, 1968.

## 7. EXTENSION OF RANGE OF THE LARGE INDIAN KITE *MILVUS MIGRANS LINEATUS* (GRAY)

Ripley in the SYNOPSIS (1961, p. 43) refers to the Large Indian Kite [*Milvus migrans lineatus* (Gray)] as wintering in the plains, but does not indicate its southern limits. It has been known to occur around Bombay, and Koelz (1942; *J. Bombay nat. Hist. Soc.* **43**:29) obtained 3 females (wings 459, 491, 510) at Londa near Castle Rock, North Kanara, between 7 January and 13 March 1938.

A few years ago, the Virus Research Centre at Poona sent to the Society a number of bird skins obtained in Mysore. We now notice that they include a male (wing 503) of this form obtained at Annandapuram, Shimoga District, Mysore, on 22 February 1960, by P. K. Rajagopalan of the Virus Research Centre.

Though North Kanara is now in Mysore, the present record is a small southward extension of the known range of this bird which is not included in Sálim Ali's BIRDS OF MYSORE.

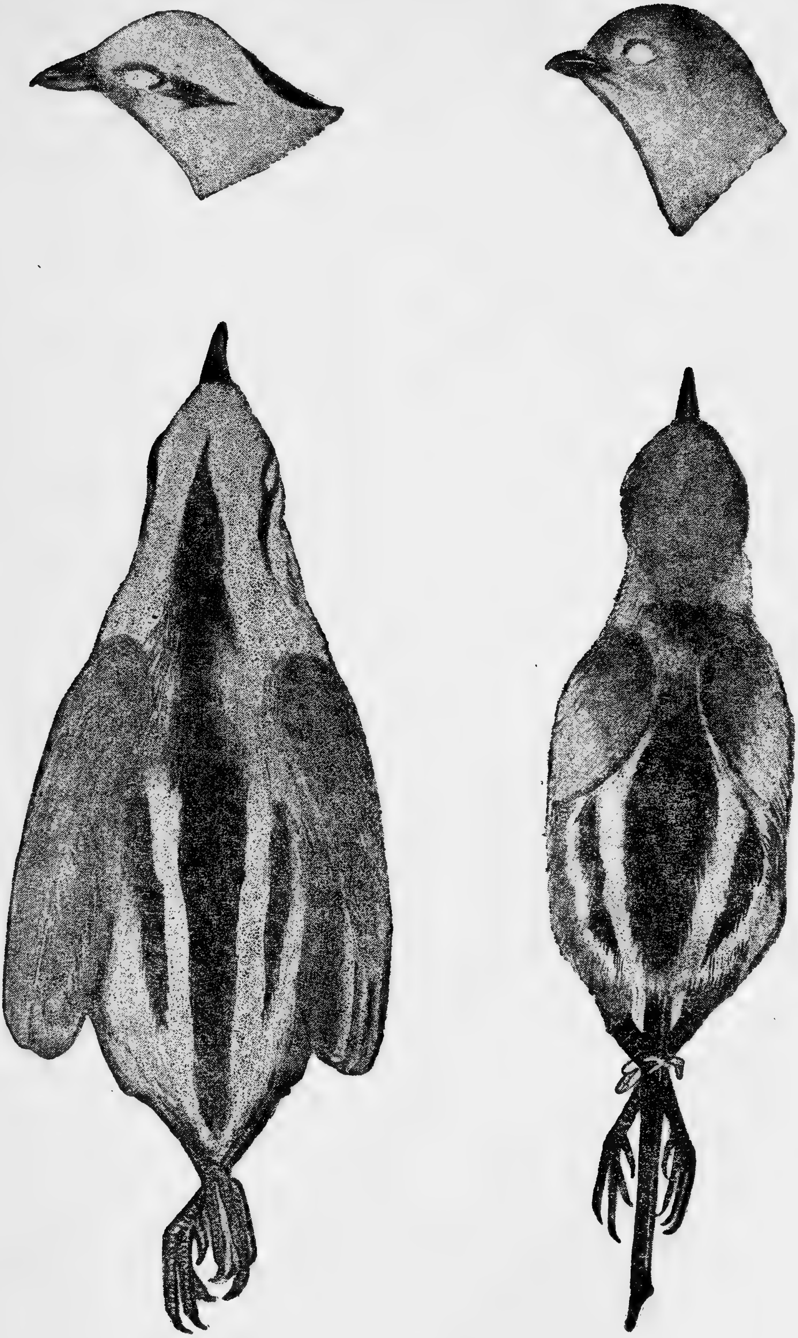
BOMBAY NATURAL HISTORY SOCIETY,
HORNBILL HOUSE, HUMAYUN ABDULALI
SHAHID BHAGAT SINGH ROAD, BOMBAY, J. G. NAIR
*April* 27, 1968.

## 8. THE CHICK OF THE RED SPURFOWL *GALLOPERDIX SPADICEA* (GMELIN)

(*With a plate*)

As the chick of the Red Spurfowl *Galloperdix spadicea* (Gmelin), does not appear to have been described, the following may be of interest: —

On the evening of 20 May 1968, while we were walking home from Dhobi's Waterfall, Mahableshwar, 4000′, Western Ghats, one of the boys (Azeem Sheikh) in the party drew my attention to a bird lying among dry leaves in the gutter by the side of the road. An examination revealed two downy chicks, obviously of a game bird, lying on their sides and kicking in the air. When picked up they



Chicks of: *Left*, Red Junglefowl; *Right*, Red Spurfowl
(Described in present note)

were incapable of standing on their legs and spasmodically threw back their heads in the way that diseased poultry chicks do. They were not much more than a day old, and though we took them home, for no parent was visible, they did not feed or survive. The specimens have been preserved in the collection of the Bombay Natural History Society and bear Nos. 22947 and 22948.

No Grey Junglefowl chick is available for comparison, but according to Stuart Baker (FAUNA **5**: 300) it is similar to the Red Junglefowl (see figure), which he describes as having 'a broad central plum-brown streak from crown to tail and a streak of the same colour through the eye' (FAUNA **5**: 297), except that 'the lateral bands (are) almost white and the sides and lower parts dull grey'.

The present specimens have no markings on the head which is cinnamon-brown. There is a dark sepia-brown band over 10 mm. wide, along the whole back, bordered by pale cream-coloured stripes about half the width on both sides. These are again edged with thinner lines of dark sepia-brown on the sides. The wing stubs and an undefined band across the upper breast are similar to the head, while the chin and underparts are paler tinged with yellowish. This is so different from the Grey Junglefowl Chick as described by Stuart Baker above that I take these to be chicks of the Red Spurfowl.

This also serves to warn us that game birds are subject to diseases afflicting domestic poultry—see note in *Journal*, **51**: 747-748.

75, ABDUL REHMAN STREET,
BOMBAY-3, HUMAYUN ABDULALI
*July* 3, 1968.

**Note**

Since writing this note I have seen the following description of a chick by Sykes (1832) *Proc. zool. Soc. London* p. 154, which has so far been overlooked.

Pullus. *Fusco-ferrugineus, vittis tribus dorsalibus latis, intermedia saturate rufo-brunnea, lateralibus flavescenti-albidis.* H. A.

## 9. A FURTHER NOTE ON THE DISTRIBUTION OF *CUCULUS CANORUS* LINNAEUS

I heard the unmistakable call of the cuckoo (*Cuculus canorous* Linnaeus) in a lovely teak forest near Sathanpalli, Khanapur Block, Adilabad District, Andhra Pradesh on July 24, 1968.

Sathanpalli is just north of the Godavari River, east of Nirmal, and is at about the same latitude as the Abdulali record of 1954 [1] in adjacent Maharashtra. According to Ripley, (SYNOPSIS, 1961) the *C. c. canorus* Linnaeus form may occur in the hills of neighbouring Madhya Pradesh and Orissa but to my knowledge this is the first record of the bird in northern Andhra Pradesh in non-wintering range.

'TREETOPS',
MEDCHAL,
HYDERABAD DISTRICT,
ANDHRA PRADESH,
*August* 4, 1968.

GEORGE F. NEAVOLL

## 10. OCCURRENCE OF THE EUROPEAN BEE-EATER *MEROPS APIASTER* LINNAEUS, AT METTUR DAM, SALEM DISTRICT, MADRAS

While working out a small collection of birds from Salem District, Madras, made in February 1952 by Dr. K. K. Tiwari of the Zoological Survey of India, I found two specimens of the European Bee-eater (*Merops apiaster* Linnaeus) from the Mettur Dam area. The specimens, both adult females, were taken on 20 February 1952.

Standard literature on Indian avifauna does not include southern India within the range of the species. The present record would, therefore, extend its range as far south as Mettur Dam area in Madras State.[2]

I am thankful to the Officer-in-Charge, Bird Section, Zoological Survey of India, for providing facilities to study the material.

ZOOLOGICAL SURVEY OF INDIA,
INDIAN MUSEUM,
CALCUTTA-13,
*June* 24, 1968.

MONISHA BASU ROY

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[1] *J. Bombay nat. Hist. Soc.* **52** : 210.

[2] These are more correctly, vagrants—Eds.

## 11. TERRITORY IN THE HOUSE CROW, *CORVUS SPLENDENS* VIEILLOT

During the past four years, 1964 to 1967, I had an opportunity to study the territorial behaviour of House Crow, *Corvus splendens* Vieillot in and around Poona. As many as 67 pairs (4 of them ringed ones) were observed for the purpose of this study. It was observed that in the case of House Crow:—

1. The territory is claimed after the nesting site has been selected.

2. The occupation of territory is announced by the mere presence of one or both of the pair.

3. Courtship and copulation usually takes place inside the territory.

4. Most of the food is obtained from outside the territory.

5. The territory is defended by both sexes by warning note, pursuit and attack.

6. Territory is occupied and defended during the breeding season only.

7. A well-marked social defence system is employed whereby several nesting pairs of the neighbourhood join the defence efforts of a threatened pair against predators.

8. The territorial limits (area of defence) vary according to the type of intruder. Intruders like others of the species and sex and small harmless birds of the other species are permitted to come up to a couple of metres without any show of hostility. Many a times a House Sparrow, *Passer domesticus* was observed to perch within a few centimetres of the nest proper while the owner (s) sat inside the nest. Raptors are assaulted on sight when within 50 to 60 metres of the nest and are chased as far away as 200 to 300 metres. Koel is attacked even when heard within 100 metres of the nest and is pursued till the pursuers are convinced of their inability to catch up with the offender. Other intruders like human beings, monkeys and carnivora are attacked only when they try to climb the nesting tree and are not left in peace till they put 200 to 300 metres between themselves and the nest, or reach a place of shelter.

It follows therefore that the House Crow, *Corvus splendens* Vieillot:—

(i) Sustains a territory which is intermediate between types B and C of Hinde's (1956: 342) classification. It is therefore suggested that one more category may be added in between Hinde's types B

and C to cover such birds who occupy large nesting territories within which courtship, copulation and nesting takes place but which do not furnish most of the food.

(ii) Occupies and defends it after the pair's selection of the nesting site, employs warning note, pursuit and assault as the chief means of defence. Defends it mainly for nesting site, nest, eggs and brood only. The main functions of the territory in *Corvus splendens* is to afford protection to nest, eggs and young, that is, the functions proposed by Nice (1933), Mayr (1935), Lack (1935), Noble (1939) and Tinbergen (1939).

ZOOLOGICAL SURVEY OF INDIA,
WESTERN REGIONAL STATION,
1182/2, F. C. ROAD,
POONA-5,
*November* 16, 1967.

B. S. LAMBA

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## 12. THE BROWN FLYCATCHER, *MUSCICAPA LATIROSTRIS* RAFFLES IN KUTCH

Once again I had the good luck to come across a new bird in Kutch and that too in the same place where I have seen most of the other new birds; the grounds of Vijaya Vilas Palace, Mandvi. On November 21 and 22, 1967, I saw the Brown Flycatcher (*Muscicapa latirostris* Raffles) in the garden which surrounds the palace. On both occasions only one bird was observed. At first glance an inexperienced observer could easily mistake it for the Red-breasted Flycatcher (*Muscicapa parva* Bechstein) a regular winter visitor in Kutch which is met with in all suitable localities. Obviously the Brown Flycatcher is an extremely rare visitor in this part of the country. Dharmakumarsinhji (BIRDS OF SAURASHTRA: 428) does not

make any reference to its occurrence in Saurashtra but says it was recorded by Littledale at Saran (Dungarpur State, now in Rajasthan) and that it is presumably resident in the Dangs (Gujarat). It appears that, at least up to the time the BIRDS OF SAURASHTRA was published, this bird does not seem to have been firmly recorded in Saurashtra.

JUBILEE GROUND,
BHUJ, KUTCH,
*April* 12, 1968.

M. K. HIMMATSINHJI

## 13. NEW WINTERING LOCALITY OF THE SPOTTED BUSH WARBLER *BRADYPTERUS THORACICUS* (BLYTH)

On 24 November 1967 whilst netting migratory birds in the phragmites reed beds at Nalbani, North Salt Lakes, Calcutta, with Mr. S. S. Saha & Mr. D. K. Ghosal, a Spotted Bush Warbler, *Bradypterus thoracicus* (Blyth) was collected. It is of interest that this constitutes the first Calcutta area record and appears to be the only record of the species' occurrence away from the Himalayan foothills or Sylhet, E. Pakistan which Ripley in his SYNOPSIS states to be its winter range. The bird was therefore inexplicably some 300 miles south of its usual wintering areas.

The Spotted Bush Warbler is a great skulker and the specimen was virtually pushed into the net by chevying it along with the hands from only two or three feet away. This may account for its not having been collected before although netting has been carried out fairly regularly in this area since 1962.

Since the above record, two other specimens have been caught at the same locality (on 28 January 1968) indicating that the species is not necessarily scarce. On no occasion, however, has the bird been observed in the field prior to its being caught in the nets.

Measurements (in mm.) of the birds collected and now in the Indian Museum, Calcutta, are as follows:—

24.xii.67 1 ♂, wing 54, tail 54, bill 14. Primaries 2nd=10th
26.i.68 1 ♂, wing 52·5, tail 49·5, bill 14. Wing tip—2—
Wing-tip damaged.
26.i.68 1 ♂, wing 51·3, tail 52. bill 13·5. Primaries 2nd=11th.
(on the latter two birds the spots on the chest are more pronounced).

I wish to record my appreciation for the help of Dr. B. Biswas of the Zoological Survey of India, India Museum, Calcutta, for his confirming the identification of the above specimens.

*Bradypterus thoracicus* (Blyth) is illustrated in Sálim Ali's BIRDS OF SIKKIM.

THE CHARTERED BANK,
CALCUTTA-1,
*March* 26, 1968.

J. R. S. HOLMES, M.B.O.U.

## 14. DUST BATHING BY COMMON BAYA (*PLOCEUS PHILIPPINUS*)

Recently, going through the chapter on Feather Maintenance in A NEW DICTIONARY OF BIRDS, I came across a statement by K. E. L. Simmons, who, while writing of Dusting says, 'Dusting is also found, for example, in sparrows (Passerinae--but not in other Ploceidae).

On the afternoon of May 4, 1962, Julian Donahue and I had gone out along Agra Canal beyond Okhla to watch a large wagtail roost which Julian had discovered the previous evening. Stopping the car on the road, we spotted a family of Bustard Quails. The land was parched and dotted with dry *Zizyphus* bushes and other kinds of thorny bushes, clump of grass and a few *keekar* trees.

A few Common Bayas (*Ploceus philippinus*) were bathing in the dust. Others were feeding on some kind of seeds from the ground.

Dust bathing by the Common Baya has since been corroborated by Mr. S. K. Kanjilal from Lucknow.

32, CHHATRA MARG,
DELHI-7,
*August* 28, 1968.

(MRS.) USHA GANGULI

## 15. SOME NEW BIRD RECORDS FOR DELHI

On 2 June 1968 I found the Collared Pratincole (*Glareola pratincola maldivarum*) nesting on the grasslands on the south-western side of the dried-up Najargarh jheel, about 20 miles south-west of Delhi.

This is the first nesting record we can trace for Delhi, although the Pratincole has been seen in every month of the year.

There were many Pratincoles in the area, some flying and others standing or sitting on the ground. As I drove my car slowly towards one it suddenly rose and threatened the car with outstretched wings. I then found two eggs resting on the ground in the short grass. There was little sign of the bird having hollowed the ground at all.

Investigation disclosed some six nests in the vicinity, and there were probably more spread over the area. I was able to bring my car within six feet of sitting birds to take photographs.

A week later Mrs. Usha Ganguli accompanied me to the spot and we found more nests. Pairs were occasionally displaying. The males, which we noted were distinctly darker at the lores and forehead, approached the females bowing low and then circling as though hollowing out a nesting place. The females were rather indifferent and usually moved away. It appeared that only females sat on the nests.

Dr. Dillon Ripley in the SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN says the Pratincole breeds irregularly in India, East Pakistan and Ceylon. My impression is that they regularly haunt the Najafgarh area during the hot weather and it is possible that they breed there regularly.

The eggs were strongly marked in the fashion of the Redwattled Lapwing (*Vanellus indicus*).

On June 23 Mrs. Ganguli and I found a number of chicks a few days old. They were very active, and generally ran away when approached. But the smaller ones would crouch and become almost invisible because of their protective speckled down.

A few House Crows (*Corvus splendens*) which flew over the area were harried by the Pratincoles.

The area is also favoured for nesting by the Indian Courser (*Cursorius coromandelicus*), and I have regularly seen pairs with young in May and June there.

In passing I might also mention the presence of six Blackbuck (*Antilope cervicapra*), females and young, near some pools on the dried up jheel—seldom seen nowadays and a sad reminder of the herds which once roamed the area.

Two other new records for Delhi were established in May when I was out with Mrs. Ganguli and Mr. Holmes. Among the waders feeding on 4 May where a sewage drain runs into the bed of the Jumna about one mile below Okhla weir we spotted Terek Sandpiper (*Tringa terek*). It kept apart from the Stints (*Calidris minutus* and *C. temminckii*) and its yellow legs showed up well. The upturned bill could only be seen when it was favourably positioned for light and background. Both here and at other wader resorts we saw fair numbers of Curlew-Sandpipers (*Calidris testaceus*) in breeding plumage.

Breeding between Finland and Lake Baikal and the Caspian Sea at the mouth of the Terek River, Terek Sandpiper is recorded as wintering in coastal and tidal areas of South Asia, and so it is interesting to have found it in the centre of India.

On 5 May Mrs. Ganguli, Mr. Holmes and I were at Pindwala jheel near Najafgarh when we saw the White-winged Black Tern (*Chlidonias leucoptera*) in the company of Whiskered Terns (*C. hybrida*). This Tern is a winter straggler which Ripley says has been recorded from Calcutta, Tripura, East Pakistan, South Andamans, Ceylon, Burma, Bombay and Saurashtra.

A few years ago Dr. Sálim Ali raised the possibility that some herons we saw at Shamaspur jheel, west of Najafgarh, might be the Great White-bellied Heron (*Ardea insignis*), which has a range from Nepal and Sikkim terai eastwards to Assam, East Pakistan, North Burma and Arakan. This year Mrs. Ganguli, Mr. Holmes and I saw several of these herons again at Shamaspur, and from the bright white of the breast and belly and the distinctly larger size than the Grey Heron (*A. cinerea*), which was also to be seen, we concluded that they were almost certainly *A. insignis*.

27 Prithviraj Road,
New Delhi, PETER JACKSON
*July* 9, 1968.

[The record of the Terek Sandpiper, largely a littoral species in India, is particularly interesting. It has been supposed to be a purely coastal migrant along the western and eastern seaboards of the Peninsula, and until quite recently had evidently not been met with far inland. The above record, and that of one netted and ringed in Bharatpur, Rajasthan, in October 1966 suggest that odd birds may now and again get mixed up with migrating flocks of other small waders and get carried along with them overland. Birdwatchers will please note to examine inland flocks of stints and spotted sandpipers more critically, especially the early arrivals and late departures. Whether this is an occasional occurrence or a more or less regular happening, but so far overlooked, needs to be established—Eds.]

## 16. SOME NEW BIRD RECORDS FOR NEPAL

While going through the manuscript notes on birds collected in Nepal by the late Lt.-Col. F. M. Bailey, British Envoy Extraordinary from 1935 to 1938, I found records of examples comprising several species previously unreported from Nepal. Since the publication of the instalment of 'The birds of Nepal' series in which those notes have been fully utilized (see Biswas, 1963, *J. Bombay nat. Hist. Soc.* **60**: 388, note), will take some more time, it is thought worthwhile

to publish the new records in the mean time. Numbers as in Ripley's SYNOPSIS, 1961.

58. **Dupetor flavicollis flavicollis** (Latham). Black Bittern.

WESTERN NEPAL : TARAI : Kanchanpur dist., Bilauri : 1 ♂ (5 Feb. 1937).

The Black Bittern is already known as resident in the Indian territories adjacent to Nepal.

119. **Mergus albellus** Linnaeus. Smew.

WESTERN NEPAL : TARAI : Kanchanpur dist., Bilauri : 1 ♀ (22 Jan. 1937).

Lt.-Col. Bailey observed several Smews in mixed flocks of teals and pintails on a lake at Bilauri.

The Smew is a sparse winter visitor to both eastern and western Uttar Pradesh, not far from western Nepal.

329. **Rallus striatus albiventer** Swainson. Bluebreasted Banded Rail.

EASTERN NEPAL : TARAI : Morang dist., Haraincha : 1 ♂ (16 Feb. 1938).

This rail is already known as resident in the Indian territories adjacent to Nepal.

1543. **Locustella certhiola rubescens** Blyth. Eastern Grasshopper Warbler.

EASTERN NEPAL : TARAI : Morang dist., Kosi River : 1 ♂ (12 Feb. 1937).

1544. **Locustella lanceolata** (Temminck). Streaked Grasshopper Warbler.

EASTERN NEPAL : TARAI : Morang dist., San Pakwa : 1 ♂ (23 Feb. 1938).

The specimen was found 'in tall marsh grass'.

Both these grasshopper warblers are known as regular winter visitors in the plains of northern Bengal, not far from Morang district of Nepal.

1581. **Phylloscopus griseolus** Blyth. Olivaceous Leaf Warbler.

CENTRAL NEPAL : NEPAL VALLEY : Kathmandu (*c.* 1372 m.) : 1 ♂ (13 Apr. 1938).

This leaf warbler has earlier been recorded on passage in the Kumaon Himalaya (Mussoorie and Almora in Uttar Pradesh) in March, April and October.

From the notes it is further found that he had also collected a female Greyheaded Lapwing, *Vanellus cinereus* (Blyth), 'in a fallow rice field' at Gauchar, Kathmandu, Nepal Valley, on 6 April 1937, and a female Chinese Bush Warbler, *Bradypterus t. tacsanowskius* (Swinhoe), 'in very thick forest' at San Pakwa, Morang district,

eastern Nepal tarai, on 23 February 1938. These two species have, however, been already recorded for Nepal by Fleming and Traylor (1964, *Fieldiana, Zool.*, **35**: 519, 541) on the basis of collections made by Mrs. Proud in 1959 and Dr. Fleming in 1961.

CALCUTTA,
*June* 17, 1968.

BISWAMOY BISWAS

## 17. RECOVERY OF RINGED BIRDS

| Ring No. and species | Date and place of ringing | Date and place of recovery | Remarks |
|---|---|---|---|
| B-4633 *Philomachus pugnax* ♂ | 26.10.1967. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.). | Mid. Dec. 1967. Moga Ferozepur Dist., Punjab. (*c.* 30° 58′ N., 74° 37′ E.) | Reported by Cadet A. S. Gill |
| AB-15004 *Philomachus pugnax* ♀ | 24.10.1967. do. | 10.1.1968. Kasrak village, Katra P.O., Shahjahanpur Dist., U.P. (*c.* 28° 2′ N., 79° 40′E.) | Reported by Harbax Singh D.S.P., Shah, jahanpur U.P. |
| C-4527 *Anas crecca* ♀ | 1.12.1967. do. | 15.12.1967. Agra, Bichpuri Station (*c.* 26° 45′ N., 77° 26′ E.) | Reported by Trilokpal Singh |
| B-16096 *Philomachus pugnax* o ? | 31.3.1967. Mitpukur, 24 Parganas Dist., 16 km. east of Calcutta. (*c.* 22° 34′ N., 88° 22′ E.) | 5.5.1967. Yakut A.S.S.R., near Nyurba (*c.* 63° 20′ N., 118° 21′ E.) | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| C-4409 *Anas crecca* ♀ | 30.11.1967. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) | 11.2.1968. Gurdaspur Dist., N. Punjab (*c.*32° 3′ N., 75° 25′ E.) | Reported by A. S. Sooch, Pharmacology Dept., Medical College, Amritsar |
| F-2369 *Anas clypeata* o? | 20.11.1967. do. | 3.2.1968. Near River Sutlej, Amritsar Dist. (*c.* 31° 10′ N., 74° 30′ E.) | Reported by Kashmir Singh, Amritsar |
| C-4288 *Anas crecca* ♀ | 24.11.1967. do. | 24.2.1968. Gorakhpur, U.P. (*c.* 26° 45′ N., 83° 22′ E.) | Reported by Mohan Singh, Gorakhpur |
| B-1602 *Philomachus pugnax* o ? | 3.10.1965. do. | 20.2.1968. Hasanpur Village, Kanayta, Moradabad Dist. (*c.* 28° 44′ N., 78° 17′ E.) | Reported by Fazal Shah Khan, Hasanpur |

RECOVERY OF RINGED BIRDS—(*contd.*)

| Ring No. and species | Date and place of ringing | Date and place of recovery | Remarks |
|---|---|---|---|
| F-3161 *Anas acuta* ♀ | 14.12.1967. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) | 22.2.1968. Shankerpur Lake, Fatehpur, Bara Banki Dist. (*c.* 25° 43′ N., 80° 38′ E.) | Reported by Naresh Singh, Wildlife Warden, (P & S) U.P. |
| C-4975 *Anas crecca* ♀ | 1.1.1968. do. | 14.3.1968. Saidu Sharif, Swat State : W. Pakistan. (*c.* 34° 40′ N., 72° 6′ E.) | Reported by Veterinary Officer, West Pakistan |
| F-3425 *Fulica atra* o ? | 27.12.1967. do. | 5.4.1968. Amritsar City (*c.* 31° 38′ N., 74° 53′ E.) | Reported by Tarlok Singh, Amritsar |
| AB-14809 *Philomachus pugnax* ♀ | 26.10.1967. do. | 31.3.1968. Satellite Town, Sargodha, W. Pakistan (*c.* 32° 4′ N., 72° 43′ E.) | Reported by Mian Khizar Hussain |
| AB-13368 *Tringa glareola* o? | 6.10.1967. do. | 23.4.1968. Salorijhalpar, Samundri, Lyallpur Dt., W. Pakistan (*c.* 30° 50′ N., 72° 39′ E.) | Reported by Amram |
| C-2543 *Anas querquedula* ♀ | 16.10.1966. do. | + 10.9.1967. Kazakh S.S.R., near Vozvyshenka (*c.* 54° 28′ N., 70° 56′ E.) | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| C-2657 *Anas crecca* ♂ | 19.10.1966. do. | + 25.10.1967. Tyumen Region, near Nizhnevartovsk (*c.* 60° 56′ N., 76° 39′ E.) | do. |
| C-3483 *Anas crecca* ♂ | 28.10.1967. do. | + 8.3.1968. Uzbek S.S.R. near Ilich (*c.* 40° 52′ N., 68° 30′ E.) | do. |
| C-3557 *Anas crecca* ♂ | 30.11.1967. do. | + 2.3.1968. Samarkand Region, near Dzhuma (*c.* 39° 44′ N., 66° 35′ E.) | do. |
| C-3643 *Anas crecca* ♂ | 5.11.1967. do. | + 10.1.1968. Tashkent Region, Chirchik River (40° 62′ N., 69° 19′ E.) | do. |
| C-3692 *Anas crecca* ♀ | 6.11.1967. do. | + 3.3.1968. Tadjik S.S.R., near Ordzhoni Kidzeabad (*c.* 38° 33′ N., 68° 58′ E.) | do. |

RECOVERY OF RINGED BIRDS—(*contd.*)

| Ring No. and species | Date and place of ringing | Date and place of recovery | Remarks |
|---|---|---|---|
| C-4730 *Anas crecca* ♂ | 3.12.1967. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) | + 11.3.1968. Kazakh S.S.R., Kyzyl Orda Region, near Dzalagash (*c.* 45° 08′ N., 64° 44′ E.). | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| C-4819 *Anas crecca* ♀ | 10.12.1967. do. | + 0.3.1968. Tadjik S.S.R. near Regar (*c.* 38° 33′ N., 68° 14′ E.) | do. |
| F-1384 *Anas acuta* ♀ | 17.10.1966. do. | + 11.3.1967. Kazakh S.S.R. Dzhambul Region, near Dzhambul (*c.* 42° 52′ N., 71° 20′ E.) | do. |
| F-3698 *Anas clypeata* o? | 31.12.1967. do. | + 20.3.1968. Tadjik S.S.R., near Asht (*c.* 40° 41′ N., 70° 21′ E.) | do. |
| F-4949 *Anas clypeata* ♂ | 16.2.1968. do. | + 10.3.1968. Samarkand Region, near Aktash (*c.* 39° 55′ N., 65° 55′ E.) | do. |
| F-5248 *Anas acuta* ♂ | 26.2.1968. do. | + 14.3.1968. Kazakh S.S.R., Alma-Ata Region, near Chundzha (*c.* 43° 30′ N., 79° 27′ E.) | do. |
| 66-300 *Sarkidiornis melanotos* o? | 4.1.1968. do. | 12.2.1968. Sahaswan, Budaun Dist. U.P., India (*c.* 28° 2′ N., 79° 7′ E.) | Reported by Mir Hafeez Ali |
| C-4848 *Anas crecca* ♀ | 13.12.1967. do. | 8.5.1968. Mastuj, Chitral, Peshawar, W. Pakistan (*c.* 36° 15′ N., 72° 35′ E.) | Reported by Israrud-Din. Sr. Lecturer, Dept. of Geography, University of Peshawar, W. Pakistan |
| C-435 *Anas crecca* ♀ | 28.11.1964. Manjhaul, Monghyr Dist., Bihar (*c.* 25° 23′ N., 86° 30′ E.) | + 5.9.1967. Buryatian, A.S.S.R., the mouth of the Selenga-delta (*c.* 52° 20′ N., 106° 30′ E.) | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| C-1252 *Anas querquedula* ♂ | 13.10.1965. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) | + 0.9.1967. Tyumen Region, near Yalutorovsk (*c.* 56° 40′ N., 66° 19′ E.) | do. |

RECOVERY OF RINGED BIRDS—(*contd.*)

| Ring No. and species | Date and place of ringing | Date and place of recovery | Remarks |
|---|---|---|---|
| C-1493 *Anas querquedula* ♂ | 10.10.1966. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) | + 13.5.1968. Tomsk Region near Teguldet (*c.* 57° 21′ N., 88° 07′ E.) | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| C-1628 *Anas querquedula* ♂ | 11.10.1966. do. | + 12.5.1968. Tomsk Region, near Francevskii (*c.* 57° 40′ N., 86° 24′ E.) | do. |
| C-3096 *Anas querquedula* imm. | 7.10.1967. do. | + 8.5.1968. Tomsk Region, near Krivosheino (*c.* 57° 24′ N., 83° 56′ E.) | do. |
| C-3258 *Anas querquedula* ♀ | 13.10.1967. do. | + 11.5.1968. Tomsk Region near Tomsk (*e.* 56° 30′ N., 84° 58′ E.) | do. |
| C-3424 *Anas crecca* ♂ | 27.10.1967. do. | + 14.4.1968. Semipalatinsk Region, near Kokpekty (*c.* 48° 45′ N., 82° 24′ E.) | do. |
| C-3875 *Anas crecca* ♂ | 7.11.1967. do. | + 11.5.1968. Tyumen Region, near Hizhnevartovskoe (*c.* 60° 55′ N., 76° 39′ E.) | do. |
| C-3973 *Anas crecca* ♀ | 9.11.1967. do. | + 9.3.1968. Tashkent Region, near Chirchik (*c.* 41° 30′ N., 81° 30′ E.) | do. |
| C-4036 *Anas querquedula* ♂ | 10.11.1967. do. | + 5.5.1968. Altai Region, near Tyumentsevo (*c.* 53° 20′ N., 81° 30′ E.) | do. |
| C-4116 *Anas crecca* ♂ | 12.11.1967. do. | + 5.5.1968. Tomsk Region, near Zyryanskoe (*c.* 56° 50′ N., 86° 38′ E.) | do. |
| C-4117 *Anas crecca* ♂ | 12.11.1967. do. | + 7.5.1968. Tyumensk Region, near Tobolsk (*c.* 58° 16′ N., 68° 18′ E.) | do. |
| C-4141 *Anas crecca* ♂ | 13.11.1967. do. | + 3.5.1968. Krasnoyarsk Region, near Eniseisk (*c.* 58° 27′ N., 92° 12′ E.) | do. |
| C-4397 *Anas crecca* ♂ | 30.11.1967. do. | + 4.5.1968. Krasnoyarsk Region, near Kemchug (*c.* 56° 12′ N., 91° 37′ E.) | do. |

RECOVERY OF RINGED BIRDS—(*contd.*)

| Ring No. and species | Date and place of ringing | Date and place of recovery | Remarks |
|---|---|---|---|
| C-4605 *Anas crecca* ♂ | 6.12.1967. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) | + 17.4.1968. Altaisk Region, near Kosikha (*c.* 53° 22′ N., 84° 34′ E.) | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| C-4607 *Anas crecca* ♀ | 6.12.1967. do. | + 10.5.1968. Tomsk Region, Vasyugan River (*c.* 58° 07′ N., 77° 00′ E.) | do. |
| C-4643 *Anas crecca* ♂ | 6.12.1967. do. | + 10.5.1968. Krasnoyarsk Region, near Kezhma (*c.* 58° 00′ N., 101° 06′ E.) | do. |
| C-4886 *Anas crecca* ♀ | 21.12.1967. do. | + 14.5.1968. Tuva A.S.S.R., near Tora-Khem (*c.* 52° 29′ N., 96° 09′ E.) | do. |
| C-5574 *Anas crecca* ♀ | 4.3.1968. do. | +3.5.1968. Novosibirsk Reg., near Severnoe (*c.* 56° 22′ N., 78° 20′ E.) | do. |
| F-1767 *Anas clypeata* o ? | 17.10.1967. do. | + 5.5.1968. Tomsk Region, near Kozhevnikovo (*c.* 56° 17′ N., 84° 00′ E.) | do. |
| F-1931 *Anas clypeata* ♂ | 2.11.1967. do. | + 9.5.1968. Krasnoyarsk Region, near Uzhur (*c.* 55° 18′ N., 89° 49′ E.) | do. |
| F-2584 *Anas clypeata* ♂ | 25.11.1967. do. | + 9.5.1968. Tomsk Region, near Kozhevnikovo (*c.* 56° 17′ N., 84° 00′E.) | do. |
| F-2840 *Anas penelope* ♂ | 5.12.1967. do. | + 9.5.1968. Irkutsk Region, near Bratsk (*c.* 56° 18′ N., 101° 44′ E.) | do. |
| F-2919 *Anas acuta* ♂ | 8.12.1967. do. | + 3.5.1968. Tyumen Region, near Repolovo (*c.* 60° 40′ N., 69° 45′ E.) | do. |
| F-5261 *Aythya ferina* ♂ | 26.2.1968. do. | + 6.5.1968. Tomsk Region, near Kozhevnikova (*c.* 56° 17′ N., 84° 00′ E.) | do. |

RECOVERY OF RINGED BIRDS—(*contd.*)

| Ring No. and species | Date and place of ringing | Date and place of recovery | Remarks |
|---|---|---|---|
| F-5322 *Aythya fuligula* ♀ | 26.2.1968. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) | + 7.5.1968. Tomsk Region, near Anastasievka (*c.* 56° 48′ N., 83° 32′ E.) | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| F-5342 *Anas clypeata* o ? | 26.2.1968. do. | + 9.5.1968. Tomsk Region, near Kozhevnikovo (*c.* 56° 17′ N., 84° 00′ E.) | do. |
| C-4632 *Anas crecca* ♀ | 6.12.1967. do. | 23.5.1968. Shot on Astor River, Kashmir (*c.* 35° 21′ N., 74° 52′ E.) | Reported by Mr. Khan, Contractor, Gilgit Agency, W. Pakistan |
| AB-14641 *Philomachus pugnax* ♀ | 25.10.1967. do. | + 22.5.1968. Yakutian A.S.S.R., near Nyurba (*c.* 63° 15′ N., 118° 00′ E.) | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| B-4071 *Philomachus pugnax* ♂ | 28.9.1967. do. | + 29.5.1968. Yakutian A.S.S.R., near Tenkeli, the Tenkeli River (*c.* 70° 14′ N., 141° 00′ E.) | do. |
| B-4078 *Philomachus pugnax* ♂ | 29.9.1967. do. | + 17.5.1968. Tyumen Region, near Surgut, (*c.* 61° 46′ N., 73° 28′ E.) | do. |
| B-4223 *Philomachus pugnax* ♂ | 9.10.1967 do. | + 0.5.1968. Yakutian A.S.S.R., near Ust-Kuigu (*c.* 70° 00′ N., 135° 38′ E.) | do. |
| C-1223 *Anas crecca* ♀ | 8.10.1965. | + 13.5.1968. Tyumen Region, near Nizhnevartovskoe (*c.* 60° 55′ N. 76° 40′ E.) | do. |
| C-3038 *Anas querquedula* o ? | 28.9.1967. do. | + 20.5.1968. Tomsk Region, near Rybinsk (*c.* 58° 25′ N., 84° 42′ E.) | do. |
| C-3537 *Anas crecca* ♂ | 29.10.1967. do. | + 20.5.1968. Krasnoyarsk Region, near Turukhansk (*c.* 65° 48′ N., 88° 00′ E.) | do. |
| C-3540 *Anas crecca* ♀ | 29.10.1967. do. | + 4.5.1968. Krasnoyarsk Region, near Kansk (*c.* 56° 15′ N. 95° 42′ E.) | do. |

RECOVERY OF RINGED BIRDS—(*contd.*)

| Ring No. and species | Date and place of ringing | Date and place of recovery | Remarks |
|---|---|---|---|
| C-3896 *Anas crecca* ♂ | 7.11.1967. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) | + 12.5.1968. Tomsk Region, near Kurgasok (*c.* 59° 01′ N., 80° 50′ E.) | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| C-4115 *Anas crecca* ♂ | 12.11.1967. do. | + 5.5.1968. Krasnoyarsk Region, near Kansk (*c.* 56° 15′ N., 95° 42′ E.) | do. |
| C-4175 *Anas crecca* ♂ | 14.11.1967. do. | + 14.5.1968. Irkutsk Region, near Chervyanka (*c.* 57° 41′ N., 99° 30′ E.) | do. |
| C-4185 *Anas crecca* ♀ | 14.11.1967. do. | + 16.3.1968. Fergana Region, near Altyar (*c.* 40° 23′ N., 71° 30′ E.) | do. |
| C-4889 *Anas crecca* ♀ | 21.12.1967. do. | + 23.5.1968. Yakutian A.S.S.R.,Lenskii Dist., near Orto-Nakhara (*c.* 60° 48′ N., 114° 12′ E.) | do. |
| C-5145 *Anas crecca* ♂ | 4.2.1968. do. | + 1.5.1968. Tomsk Region, near Asino (*c.* 57° 04′ N., 86° 08′ E.) | do. |
| C-5163 *Anas crecca* ♀ | 4.2.1968. do. | + 16.5.1968. Irkutsk Region, the Kochengu River (*c.* 56° 00′ N., 103° 51′ E.) | do. |
| C-5277 *Anas crecca* ♂ | 1.3.1968. do. | + 16.5.1968. Jakutsk Region, Lenskii Dist., near Khamra (*c.* 60° 18′ N., 114° 09′ E.) | do. |
| F-1813 *Anas acuta* ♂ | 23.10.1967. do. | + 15.5.1968. Irkutsk Region, Taishet Dist., near Kondratievo (*c.* 57° 24′ N., 98° 10′ E.) | do. |
| F-1839 *Anas acuta* ♂ | 25.10.1967. do. | + 14.5.1968. Tomsk Region, near Parabel, (*c.* 58° 43′ N., 81° 27′ E.) | do. |
| F-1870 *Anas acuta* o ? | 26.10.1967. do. | + 24.5.1968. Yakutian A.S.S.R., near Mirnyi (*c.* 62° 32′ N., 113° 43′ E.). | do. |

RECOVERY OF RINGED BIRDS—(*contd.*)

| Ring No. and species | Date and place of ringing | Date and place of recovery | Remarks |
|---|---|---|---|
| F-2218 *Anas acuta* ♂ | 10.11.1967. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) | + 9.3.1968. Samarkand Region; near Gallyaaral (*c.* 40° 01′ N., 67° 34′ E.) | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| F-2957 *Anas clypeata* ♂ | 9.12.1967. do. | + 14.5.1968. Tomsk Region, near Kolpashevo (*c.* 58° 21′ N., 82° 56′ E.) | do. |
| F-3402 *Anas clypeata* ♂ | 23.12.1967. do. | + 17.5.1968. do. | do. |
| F-3412 *Aythya fuligula* ♂ | 23.12.1967. do. | + 18.5.1968. do. | do. |
| F-3993 *Anas clypeata* o ? | 12.1.1968. do. | + 10.5.1968. Tomsk Region, near Tomsk (*c.* 56° 30′ N., 85° 01′ E.) | do. |
| F-4249 *Anas acuta* ♂ | 24.1.1968. do. | + 10.5.1968. Tomsk Region, near Aleksandrovskoe (*c.* 56° 46′ N., 85° 22′ E.) | do. |
| F-4336 *Fulica atra* o ? | 29.1.1968. do. | + 14.5.1968. Tomsk Region, near Kolpushevo (*c.* 58° 21′ N., 82° 56′ E.) | do. |
| F-4556 *Aythya fuligula* ♂ | 5.2.1968. do. | + 12.5.1968. do. | do. |
| F-5071 *Aythya ferina* ♂ | 20.2.1968. do. | + 23.5.1968. Tyumen Region, Berezovo Dist., near Ustrem (*c.* 64° 18′ N., 65° 26′ E.) | do. |
| F-5251 *Anas acuta* ♀ | 26.2.1968. do. | + 10.5.1968. Tyumen Region, near Nadym (*c.* 65° 38′ N., 72° 45′ E.) | do. |
| F-5257 *Anas acuta* ♂ | 26.2.1968. do. | + 10.5.1968. Tomsk Region, Parabel Dist., near Visokii Yar (*c.* 58° 48′ N., 81° 21′ E.) | do. |
| F-5340 *Anas clypeata* ♀ | 26.2.1968. do. | + 17.5.1968. Tomsk Region, near Kolpashevo (*c.* 58° 21′ N., 82° 56′ E.) | do. |
| F-5389 *Aythya fuligula* ♀ | 27.2.1968. do. | + 12.5.1968. Tomsk Region, near Malchanovo (*c.* 57° 35′ N., 83° 45′ E.) | do. |

RECOVERY OF RINGED BIRDS—(*contd.*)

| Ring No. and species | Date and place of ringing | Date and place of recovery | Remarks |
|---|---|---|---|
| F-5678 *Anas clypeata* ♀ | 3.3.1968. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) | + 8.5.1968. Krasnoyarsk Region, Eniseisk Dist., near Makovskoe (*c.* 58° 12′ N., 90° 52′ E.) | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| F-3191 *Fulica atra* o ? | 15.12.1967. do. | + 0.1.1968. Nabishah Lake, Bhalwal Tehsil, Dist., Sargodha, W. Pakistan (*c.* 32° 4′ N., 72° 43′ E.) | Reported by Mian Muhammad Amir |
| AB-9228 *Tringa glareola* o ? | 9.10.1966. do. | + 8.6.1968. Krasnoyarsk Region, near Igarka (*c.* 67° 28′ N., 86° 34′ E.) | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| B-1659 *Philomachus pugnax* ♂ | 7.10.1965. do. | + 18.5.1968. Yakutian A.S.S.R., Ust, Aldan Region, Aldan River (*c.* 63° 18′ N., 131° 00′ E.) | do. |
| C-2695 *Anas crecca* ♂ | 20.10.1966. do. | + 29.2.1967. Turkmenian S.S.R., near Mary (*c.* 37° 37′ N., 61° 49′ E.) | do. |
| C-3323 *Anas crecca* ♂ | 16.10.1967. do. | + 0.3.1968. Syr-Dariya Region, near Gulistan (*c.* 40° 30′ N., 68° 45′ E.) | do. |
| C-3672 *Anas crecca* ♂ | 5.11.1967. do. | + 14.6.1968. Krasnoyarsk Region, near Norilsk (*c.* 69° 20′ N., 88° 14′ E.) | do. |
| C-3992 *Anas crecca* ♂ | 9.11.1967. do. | + 29.4.1968. Novasibirsk Region, near Verkhnyaya Krasnoyarka (*c.* 56° 22′ N., 77° 56′ E.) | do. |
| C-4285 *Anas crecca* ♂ | 24.11.1967. do. | + 12.5.1968. Tomsk Region, near Kolpashevo (*c.* 58° 21′ N., 82° 56′ E.) | do. |
| C-4734 *Anas crecca* ♀ | 8.12.1967. do. | + 8.5.1968. Tomsk Region (*c.* 56° 75′ N., 85° 15′ E.) | do. |

RECOVERY OF RINGED BIRDS—(*contd.*)

| Ring No. and species | Date and place of ringing | Date and place of recovery | Remarks |
|---|---|---|---|
| C-5109 *Anas crecca* ♂ | 29.1.1968. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) | + 15.5.1968. Irkustsk Region, near Kirensk (*c.* 57° 46′ N., 108° 08′ E.) | Reported by Bird Ringing Centre, Moscow, U.S.S.R. |
| F-1117 *Anas acuta* ♂ | 18.10.1965. do. | + 15.5.1967. Tomsk Region, near Aleksandrovskoe (*c.* 56° 46′ N., 85° 22′ E.) | do. |
| F-4200 *Aythya fuligula* o ? | 23.1.1968. do. | + 15.5.1968. Tomsk Region, near Podgornoe (*c.* 57° 47′ N., 82° 38′ E.) | do. |
| F-4416 *Anas acuta* ♂ | 31.1.1968. do. | + 16.5.1968. Tomsk Region, Surgut Dist., near Sytomino (*c.* 61° 20′ N., 71° 20′ E.) | do. |
| F-5058 *Anas acuta* ♀ | 19.2.1968. do. | + 30.4.1968. Omsk Region, near Krutinka (*c.* 56° 00′ N., 71° 31′ E.) | do. |
| F-5355 *Aythya ferina* ♀ | 26.2.1968. do. | + 0.2.1968. Surkhan-Dariya Region, near Termez (*c.* 37° 11′ N., 67° 18′ E.) | do. |
| F-4951 *Fulica atra* o ? | 16.2.1968. do. | + 15.4.1968. Kazakh S.S.R., Karaganda Region, southern coast of Balkash Lake (*c.* 46° 85′ N., 75° 00′ E.) | do. |
| F-5500 *Anas clypeata* ♂ | 28.2.1968. do. | + 20.4.1968. do. | do. |
| C-3712 *Anas crecca* ♂ | 6.11.1967. do. | 16.8.1968. Bairwar Village, P.O. Jatara, Dist. Tikamgarh, MP. (*c.* 24° 45′ N., 78° 50′ E.) | Reported by Dhani Ram Singh, M.P. |

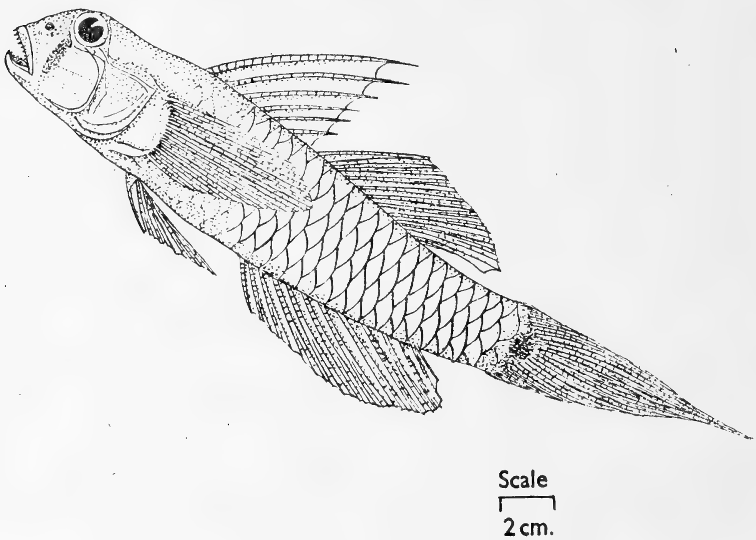
BOMBAY NATURAL HISTORY SOCIETY,
HORNBILL HOUSE,
SHAHID BHAGAT SINGH ROAD,
BOMBAY-1,
*October* 17, 1968.

EDITORS

## 18. *OXYURICHTHYS JAARMANI* WEBER (GOBIIDAE: PISCES), A RARE GOBIOID FROM INDIAN WATERS

(*With a text-figure*)

Koumans (1941) reports two species of *Oxyurichthys* from Indian waters namely, *O. microlepis* (Bleeker) and *O. tentacularis* (C.V.).




Text-Fig. *Oxyurichthys jaarmani* Weber

During my studies on the taxonomy of the fishes from the Orissa coast, a specimen of *Oxyurichthys* collected from the Mahanadi estuary on 15 March, 1964 by Sri. N. V. Subba Rao of the Zoological Survey of India was determined as *O. jaarmani* Weber. This species has so far been recorded only from the estuary of the Lorentz River, New Guinea (Koumans 1953), its type locality. The present communication records the occurrence of this rare gobioid for the first time from Indian waters.

### **Oxyurichthys jaarmani** Weber

(*Text-fig.*)

*Oxyurichthys jaarmani* Weber, 1913, *Nova Guinea*, **9**(4), p. 601 ; Koumans, 1953, *Fishes Indo Australian Archipelago*, **10**, p. 40.

*Oxyurichthys jaarmani* Fowler, 1928, *Mem. B.P. Bishop Mus.*, **10**, p. 415.

MATERIAL : 1, 78 mm. in total length ; False Point (Mahanadi estuary, Orissa) ; 15 March, 1964 ; N. V. Subba Rao ; Zoological Survey of India Reg. No. F $\frac{5531}{2}$.

*Description:*

D. VI+I. 10; A. I. 11; P. 21; L. I. 28; L. tr. 7; Gillrakers 1+4.

Depth of body 4·1; length of head 3·5; both in standard length. Eye diameter 3·9 in head; interorbital 4·0 in eye diameter.

Mouth cleft nearly horizontal, jaws subequal. Maxilla extends to level of anterior third of eye. Interorbital pores indistinct. No ocular tentacles.

Single row of fine canniform teeth in upper jaw, in three rows in lower jaw. Palate and tongue edentate.

Gill openings moderately restricted, open laterally somewhat below a level from lower edge of pectoral base; isthmus moderate. Gill-rakers well developed.

Squamation well developed on body; absent on head, median predorsal and on breast before pelvics; scales ctenoid, smaller and less ctenoid anteriorly.

Dorsals prominent; anal similar to second dorsal. Anal originates below the second dorsal ray. Pectoral longer than head and pelvic. Caudal long, pointed; longer than head.

Colour in alcohol—brownish, the vertical and paired fins dusky black. A conspicuous dark vertical band below the eye and indistinct dark blotch on caudal base.

*Remarks:* The specimen from the Mahanadi estuary differs from the original and subsequent descriptions of this species (Weber 1913; Fowler 1928, and Koumans 1953) in having a lesser number of scales in the lateral series, greater body depth and considerably smaller eye. Another variation noticed is that the interorbital pores are indistinct in the present specimen. However, in the absence of significant differences in the meristic counts, morphometric proportions and coloration, the Mahanadi specimen cannot be treated as a separate subspecies in spite of the geographical separation.

I am thankful to Dr. A. P. Kapur and Dr. A. G. K. Menon, Zoological Survey of India, Calcutta for their encouragement and interest during the course of this study.

ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA, P. K. TALWAR
*December* 8, 1967.

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WEBER, M. (1913): Susswasserfische aus neiderlandisch sud und nord neu Guinea. *Nova Guinea*, **9** (4): 601.

## 19. OBSERVATIONS ON THE FOOD OF YOUNG *HILSA ILISHA* (HAMILTON) AROUND NABADWIP, IN THE HOOGHLY ESTUARY

Although considerable knowledge has been gained on different aspects of the biology and fishery of *Hilsa ilisha,* (1963) not much is known on the food and feeding habits of the young *Hilsa.* Hence, an attempt was made to make a detailed analysis of the food of the young *Hilsa ilisha* around Nabadwip in the Hooghly estuary.

The material for the present investigations was obtained from the freshwater zone of the Hooghly in and around Nabadwip during March to June, 1966. 649 specimens of the young of *Hilsa ilisha* in the size range of 65 to 200 mm. (total length) were collected from regular fortnightly random samples and analysed for their gut contents. The fish in fresh condition, were either directly obtained from shore-seines (*Chat Berjal*) or from the Nabadwip fish market. They were preserved in 5% formaldehyde and the gut contents were analysed by the 'Occurrence' method, though it has some limitations. As the observations were of preliminary nature, other methods like volumetric analysis which could have pin-pointed the 'real optimal food' for the species, were not tried.

The relative abundance of various food items present in the gut contents of the young *Hilsa* has been found to be crustacea 26·71%, sand particles 23·50%, debris 18·39%, digested matter 15·49%, diatoms 13·35%, algae 0·50%, animal tissue 0·04% and bivalve larvae 0·01%. The data relating to monthwise fluctuations in the intensity of feeding as well as prevalence of various food items are presented in Table 1,

TABLE 1

PERCENTAGE PREVALENCE OF VARIOUS FOOD ITEMS DURING DIFFERENT MONTHS

| | Crustacea (%) | Sand-particles (%) | Debris (%) | Digested matter (%) | Diatoms (%) | Algae (%) | Bivalve larvae (%) | Animal tissue (%) |
|---|---|---|---|---|---|---|---|---|
| March | 36·54 | 21·16 | 14·58 | 22·72 | 3·21 | 1·69 | 0·04 | 0·06 |
| April | 28·86 | 27·95 | 22·93 | 14·32 | 5·82 | 0·03 | 0·05 | 0·04 |
| May | Nil | 23·33 | 57·50 | 14·17 | 5·00 | .. | .. | .. |
| June | 0·30 | 5·00 | 3·55 | 10.00 | 81·15 | .. | .. | .. |

from which it will be observed that marked variations in the intensity of feeding of the young *Hilsa* are evident during this period of four

months. Pillay & Rao (1962) have observed that from January to March feeding of young *Hilsa* of the river Godavari appears to be fairly intensive with the peak in February and March. They also observed that from April to July hardly any specimen was found to have eaten much food as most of them had empty stomachs or had only traces of food. The present observations reveal that, in the case of Hooghly young *Hilsa*, feeding appears to be fairly intensive in March and April. Monthwise percentage composition of the different degrees of fullness of stomachs is given in Table 2.

TABLE 2

MONTHLY FLUCTUATIONS IN THE INTENSITY OF FEEDING

| | Full (%) | $\frac{3}{4}$th Full (%) | $\frac{1}{2}$ Full (%) | $\frac{1}{4}$ Full (%) | Traces (%) | Empty (%) |
|---|---|---|---|---|---|---|
| March .. | 18·57 | 5·71 | 17·86 | 17·86 | 11·43 | 28·57 |
| April .. | 34·55 | 4·73 | 20·00 | 7·63 | 5·82 | 27·27 |
| May .. | .. | .. | 0·93 | 1·85 | 2·77 | 94·45 |
| June .. | 12·70 | .. | 4·76 | 3·17 | 3·97 | 75·40 |

*Hilsa* is generally considered a plankton feeder, though Hora & Nair (1940 a & b) inferred that young *Hilsa* feed at the bottom, since sand grains were found in the stomachs. Pillay & Rao (1962) have concluded that *Hilsa* feeds at the bottom during the entire period of its life from at least 43 mm. stage, but they have also assumed that *Hilsa* feeds at all depths, as sand grains, debris, planktonic organisms etc. are found in appreciable quantities.

ACKNOWLEDGEMENTS

The author is greatly thankful to Dr. V. G. Jhingran, Director, for his keen interest and encouragement, to Mr. V. R. Pantulu, who constantly guided the investigations and to Dr. V. Gopalakrishnan for kindly going through the manuscript.

CENTRAL INLAND FISHERIES
RESEARCH INSTITUTE, D. D. HALDER
BARRACKPORE,
*Via*. CALCUTTA,
*August* 16, 1968.

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## 20. ON THE MECHANISM OF ESCAPE BY A MOTH FROM ACCIDENTAL DROWNING

The use of surface tension of water and the hydrophobe and water repellant properties of the cuticle and cuticular processes by various aquatic insects for locomotion, and suspension from the surface film and for respiration under water has been explained by Wigglesworth (1966)[1] who has also mentioned that terrestrial insects make use of surface forces in order to cling to surfaces too smooth to provide a firm hold for the claws.

Terrestrial insects, under certain circumstances, may also take advantage of the above factors for their survival, as observed in the following case. A small unidentified moth, about a centimetre in length was found on the surface of water contained in a shallow vessel, about ten centimetres in diameter. The moth obviously, must have fallen into water accidentally. Its behaviour on the water surface was interesting. The insect was seen walking a few steps on the surface film and suddenly jumping and vibrating the wings, apparently trying to take off. It repeatedly fell back on water but remained on the surface without any active effort on its part. The moth finally succeeded after a jump, flew for a short distance and landed on the ground a few centimetres away from the vessel. The moth was caught and examined and no trace of water could be found on any part of the body.

The above observation shows how a terrestrial insect can take advantage of the surface tension of water and the hydrophobe properties of the cuticle to escape from accidental drowning.

DEPARTMENT OF ZOOLOGY,
MALABAR CHRISTIAN COLLEGE,
CALICUT 1, KERALA,
*March* 25, 1968.

A. B. SOANS
J. S. SOANS

[1] Wigglesworth, V. B. (1966): Insect Physiology. London.

## 21. *ETIELLA ZINCKENELLA* TREITSCHKE (LEPIDOPTERA: PHYCITIDAE) AS A POD BORER OF LENTIL IN THE PUNJAB

*Etiella zinckenella* T. was first reported in India in the beginning of this century as a pest of horse gram (*Dolichos biflorus* Linn.), cowpea (*Vigna catiang* Walh.), red gram (*Cajanus cajan* Sprengl.) and sannhemp (*Crotalaria juncea* L.) (Fletcher 1914). Mitra (1944), Singh & Sohi (1957) reported it as a pest of pea pods.

Recently the insect was observed doing serious damage to the pods of lentil (*Lens esculenta* Moench.) at the Punjab Agricultural University Farm, Ludhiana, and this is the first record of damage done by this insect to lentil crop in India.

The adults of *E. zinckenella* are greyish brown with distinct pale white band along the coastal margin of the fore-wing and a transverse ridge of raised scales near the base. The hind wing is semi-transparent and light in colour. The eggs are laid at the time of flowering near the calyx and on hatching the larvae bore into the pods and feed on the developing grains. Usually one larva is present per pod. A single larva attacks a number of pods before it is full-grown. The larvae are green in colour and turn pinkish-brown near maturity. Full grown larva measures about 1·0-1·25 cm. After attaining maturity, the larvae leave the pods, enter the soil and spin silken cocoons about 2 cm. to 3 cm. deep in the soil. The cocoons are covered with particles of soil.

Maximum damage to the lentil crop was done when the pods were nearing maturity. All the seeds in the infested pods were destroyed and such pods contained small larval faecal pellets and were found webbed together in clusters. Twelve to fifteen per cent pods of the crop was damaged by this insect. The larvae were parasitised by *Bracon* sp., *Tetrastichus* sp. and *Pteromalid* sp.

### ACKNOWLEDGEMENT

The authors are thankful to Dr. B. R. Subbarao for the identification of the parasites of *E. zinckenella* T.

DEPARTMENT OF ZOOLOGY-ENTOMOLOGY,
PUNJAB AGRICULTURAL UNIVERSITY,
LUDHIANA,
*March* 8, 1968.

G. S. SANDHU
G. C. VERMA

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## 22. GREGARIOUSNESS AND MIMICRY DURING THE COCOON STAGE BY THE BUTTERFLY *EUREMA HECABE* (L.)

I would refer to B. K. Tikader's note under the above heading (1968, *J. Bombay nat. Hist. Soc.*, **65** (1): 242).

*E. hecabe* does not spin a cocoon and this term should be replaced by 'pupa' wherever it occurs.

Apart from the Hesperiidae, or Grypocera, the only butterfly larvae that spin cocoons are the genus *Parnassius* and the Satyrid *Eumenis semele* L.

MOMBASA,
*July* 24, 1968.

D. G. SEVASTOPULO, F.R.E.S.

## 23. INSECTS ATTRACTED TO LIGHT IN THE DANGS, SOUTH GUJARAT

While going through the specimens collected at light in the Dangs and reported in this *Journal* **61** (2): 271 and **64** (2): 256 and now in the collections of the Society, it was noticed that through oversight three species of butterflies, collected in August-Sept, 1961 were not included in the lists published. They are:

1. *Anaphaeis aurota* Fab. (Pieridae)
2. *Colotis calais* Cr. (Pieridae) and
3. *Heliophorus tamu tamu* Koll (Lycaenidae).

This note is of special interest because while the first two species are common in this area the third *Heliophorus*, is being noted for the first time so far south. All the species of *Heliophorus* are found only in the Himalayas or at the foot of that range. Finding one of the species so far south is of great interest.

BOMBAY NATURAL HISTORY SOCIETY,
HORNBILL HOUSE,
SHAHID BHAGAT SINGH ROAD,
BOMBAY-1,
*September* 19, 1968.

N. T. NADKERNY
E. M. SHULL

## 24. PERSISTENT VITALITY IN BEE-HOLE BORER MOTH *DUOMITUS LEUCONOTUS* WLK.

At page 447 of Vol. 63 of the *Journal* Mr. Thomas Gay reports a case of persistent vitality in the Hooded Grasshopper *Teratodes monticollis*. I report here a similar case which I came across a few days ago in the bee-hole borer moth *Duomitus leuconotus* Wlk.

I caught the moth on the trunk of a *Cassia renigera* in my garden in the first week of this month, holding itself in a vertical position with its head uppermost. I took it to be a newly emerged imago and, as it was about 8 o'clock on a damp dull morning, guessed that it was not ready to fly. Placing my hand close against the trunk just in front of the moth I nudged gently at its head. The moth moved forward and settled on my right forefinger, which I held vertically thereafter so that the moth resumed its former vertical position. Coming into the house, I got out my killing bottle from the back of a book cupboard, opened it, and closed it over the moth. In between, I exhibited the moth to my wife and my daughter for their due admiration. All this was done slowly and deliberately, so as not to disturb the moth unduly. Altogether, I must have had the moth under my observation for at least ten minutes. Throughout this time, neither I nor my wife nor my daughter noticed anything unusual about the moth; it behaved as any recently emerged moth might have done. I was surprised therefore, when I opened the killing bottle two or three days later, to find the abdomen of the moth missing.

My killing bottle closes with a well-fitting lid, and was not touched by anyone in the intervening period. So there was no possibility of anything having got at the moth after its capture. The conclusion seems unavoidable therefore that that the moth had no abdomen when I caught it. It is difficult to say what the loss of the abdomen was due to; possibly, it was caused by a lizard or some other predator which was disturbed before it could destroy the moth entirely. It is clear, however, that the loss of the abdomen did not prevent the rest of the body from behaving as it would otherwise have done; so much so, that all three of us who saw it took it to be an undamaged specimen fit to be sent to the Society for its collection.

Unfortunately, it did not strike me at the time to look for the discarded pupal case. I did so about six days later and found a fresh one protruding from an exit hole within a couple of feet of the place where I caught the moth. This was the only pupa skin to be seen, except for a very old pupal case which was too old to be

considered. So it is possible that my guess about the moth being newly emerged was correct.

Mr. N. T. Nadkerny at the Society's office, who kindly verified my identification, agrees with me that this is a case of persistent vitality similar to the one described by Mr. Gay.

65 PALI HILL,
BANDRA, BOMBAY 50-AS, D. E. REUBEN
*September* 13, 1968.

[An instance of persistent vitality is given by M. A. Wynter-Blyth in his article 'The Nilgiris Revisited' in vol. **48** (1949) of this *Journal.* Writing on the Nilgiri Tiger Beetle (*Cicindela aurofasciata*) preying on the longicorn beetle (*Dorysthenes montanus*), he states that 'It is no uncommon sight to see one of these longicorns (which, if helpless against their enemies, are at least tenacious of life) walking briskly about though entirely disembowelled'—Eds.]

## 25. PREFERENCE OF CASTOR VARIETIES FOR FEEDING AND OVIPOSITION BY THE LEAFHOPPER *EMPOASCA FLAVESCENS* (F.) (HOMOPTERA, JASSIDAE)

I was very interested in S. Jayaraj's paper under this title (1968, *J. Bombay nat. Hist. Soc.* **65** (1): 64-75) as some years ago Dr. V. G. L. van Someren recorded that the larva of *Charaxes etesipe* Godt., (Lepidoptera, Rhopalocera) *etesipe*, would only eat the green-, or white-, stemmed variety of Castor, and preferred to starve rather than eat the red-stemmed, although both varieties were considered to belong to the same species by the Kew authorities. This is particularly strange as the larva of this subspecies also feeds on other Euphorbiaceae such as *Phyllanthus, Tragia* and *Croton*, whilst the larva of ssp. *tavetensis* Roths. feeds on Leguminosae, such as *Afzelia* and *Cassia* (Caesalpinaceae), *Dalbergia* (Papilionaceae) and *Entada* (Mimosaceae). With a monophagous larva such selectivity is understandable, but not when a larva feeds on several species of plant.

Has Mr. Jayaraj noticed any correlation between acceptability and stem colour?

MOMBASA, D. G. SEVASTOPULO, F.R.E.S.
*July* 24, 1968.

## 26. OBSERVATIONS ON A MODE OF FOOD-CAPTURE BY DRAGON FLIES

Dragon flies are active predators known for their habit of capturing their prey on the wing. They feed on other small insects and it is generally known that these prey-species belong to orders Odonata, Diptera, Hymenoptera and Coleoptera (Hobby 1934). In the Malabar Christian College compound, certain Aeschnid dragonflies (unidentified) are generally found resting on an extensive patch of grass, in the evening after about 6 p.m. On May 10, 1968, there was a swarm of alate termites which came out earlier than usual, before crepuscular period. The dragonflies which were resting on the grass then started capturing the termites flying over the grass one by one, in an interesting manner. The dragonfly suddenly made a swift flight, taking the course of an arc or almost a semi-circle and seized the termite, flying at a height of 1-3 metres above the grass. The position of the body of the dragonfly was nearly horizontal during the capture of prey. After food capture, the flight was continued as a deep dive back to grass on which the dragonfly rested again and ate the prey.

The above observation shows that the resting dragonflies can also capture flying prey species of insects by suddenly darting at them accurately and that order Isoptera also should be added to the list of the orders of the prey insect species of dragonflies.

Department of Zoology,
Malabar Christian College,
Calicut-1, Kerala,
*June* 5, 1968.

A. B. SOANS
JOYCE S. SOANS

Reference

Hobby, B. M. (1934): The prey of British Dragonflies. *Trans. ent. Soc. S. England.* **8** : 65.

## 27. *DICRAEIA STYLOSA* WIGHT (PODOSTEMACEAE)—A NEW RECORD FOR BOMBAY

The genus *Dicraeia* Thou. (=*Dicraeia* Tul.) with about 13 species occurs in parts of S. America, S. Africa, India and Ceylon. During a botanical exploration of Sakarpathar-Ambavane region on the Western Ghats of India, Poona District, Maharashtra State, in the years 1962-65, a species of *Dicraeia*, namely *D. stylosa* was collected.

This species has not been included in T. Cooke's THE FLORA OF THE PRESIDENCY OF BOMBAY, and has not been reported by subsequent workers from the presidency. Hence, its occurrence in the Sakarpathar-Ambavane region is considered as a new record. This species has so far been reported from Malabar Hills, Anaimalais, Nilgiris, south Kanara to Travancore. The present report extends its distribution further north along the Western Ghats.

**Dicraeia stylosa** Wight, Icon. t. 1917, f. 2, 1852; Willis in Ann. R. bot. Gard. Peradeniya 1:225, 1902; Engl. in Engl. & Prantl, Nat. Pflanzenfam. 18a: 51, f. 42, 1930; Subramanyam, Aq. Angiosp. 47, f. 31, 1962. *Podostemon stylosus* Benth. in Benth. & Hook., Gen. Pl. 3: 112. 1880; Hook. f. Fl. Brit. India 5:64, 1886.

Aquatic herb, submerged. Stems very long, ramous, compressed. Leaves 4, subulate, imbricate, distichous; the exterior pair smaller; the interior pair obtuse, subcuspidate, nearly equalling and sheathing the spathe at base. Flowers bisexual, zygomorphic. Stamens 2, filaments united below. Staminodes 2, linear, stigmas pubescent long. Ovary ovoid, 2-celled. Capsule 6-8-ribbed.

This species grows in freshwater streams, with the thallus freely floating from an attached base, exogenously branched, resembling in habit some of the seaweeds like *Fucus*. The taxon has been observed growing in association with other Podostemons like—*Griffithella hookeriana* (Tul.) Warm. and *Podostemon subulatus* Gardn., and occurs in fairly large abundance. The species is characterised by the long stigmas.

*Flowering and fruiting:* September-November.

*Specimens examined:* Rajni near Saltar (Ambavane), *Reddi* 99153A (BSI); Polarahwada near Tiskari (Ambavane), alt. 1100 m., *Reddi* 101036 (BSI).

DEPARTMENT OF BOTANY,
BANARAS HINDU UNIVERSITY,
VARANASI-5,
*June* 20, 1968.

B. VENKATAREDDI

## 28. OBSERVATIONS ON THE HOST RANGE IN *LORANTHUS LONGIFLORUS* DESV.

Previous reports on the loranthaceous parasites (Fischer 1926, Sambandam 1966) seem to justify in unambiguous terms that there is no specificity in the selection of host plants for *Loranthus longiflorus* Desv. The present authors have observed, in addition to previous

record (Sambandam 1966), a few more species of host plants which were found parasitized by *L. longiflorus*, as listed below:

*Annona squamosa* Linn., *Crateva religiosa* Forst., *Oncoba spinosa* Linn., *Gossypium arboreum*, *Thespesia populnea* Cav., *Berrya ammonilla* Roxb., *Grewia tiliifolia* Vahl, *Citrus aurantium* Linn., *C. medica* L., *Ochna squarrosa* Linn., *Azadirachta indica* A. Juss., *Cedrela toona* Roxb., *Sweitenia mahagoni* Linn., *Melia azedarach* Linn., *Moringa oleifera* Lam., *Cassia siamea* Lam., *Bauhinia tomentosa* Linn., *Anogeissus acuminata* Wall., *Quisqualis indica* Linn., *Punica granatum*. *Ixora coccinea* Linn., *Hamelia patens*, *Morinda tinctoria* Roxb., *Mimusops elengi* Linn., *M. hexandra* Roxb., *Bassia latifolia* Roxb., *Achras sapota* Linn., *Nyctanthes arbor-tristis* Linn., *Thevetia neriifolia* Juss., *Cordia rothii* R. & S., *Spathodea campanulata* Beauv., *Stereospermum chelonoides* DC., *Dolichandrone falcata* Seem., *D. rheedii* Seem., *Crescentia cujete* Linn., *Vitex negundo* Linn., *Premna latifolia* Roxb., *Lantana aculeata* Linn., *Putranjiva roxburghii* Wall., *Trema orientalis* Bl., *Holoptelea integrifolia* Planch.

It would appear, from the foregoing list of host plants, that nowhere in the study of angiospermic parasites has there been such a wide range of host plants affected by a single parasitic species.

DEPARTMENT OF BOTANY,
ANNAMALAI UNIVERSITY,
ANNAMALAINAGAR,
*May* 20, 1968.

R. SAMPATHKUMAR
J. KUNCHITHAPATHAM

REFERENCES

FISCHER, C. E. C. (1926): Loranthaceae of Southern India and their host plants. *Rec. Bot. Sur. India* **11**(1): 159-195.

SAMBANDAM, C. N. (1966): Some new combinations of *Loranthus longiflorus* Desv. and host species. *Annamalai Univ. Agric. Mag*. 63-64.

## 29. NOMENCLATURE NOTES ON THE GENUS *SONERILA* ROXB. (MELASTOMATACEAE)

1. **Sonerila khasiana** C. B. Clarke in Hook. f. Fl. Brit. Ind. 2:539, 1879; Cogniaux in DC. Monogr. Phan. 7:514, 1891; Stapf in Ann. Bot. 6:309, 1892; C. E. C. Fischer in Kew Bull. 199, 1932; et in Rec. Bot. Sur. Ind. 12:2, 96, 1938. Type: *Hooker & Thompson* 2027 (K). *Gassebeerie khasiana* (C. B. Clarke) *O. Kuntze*, Rev. Gen. Plant. 1:245, 1891. *Sonerila villosa* C. E. C. Fischer in Kew Bull. 199, 1932 et in Rec. Bot. Sur. Ind. 12:2, 96, 1938. Type: *W. J. L. Wenger* 323 (K). SYNON. NOV.

*Distribution:*

INDIA: Assam, Khasia hills, Mamloo, Kalapani, alt. 1333-1666 m., 5 Aug. 1850, *Hooker & Thompson* 2027 (K); Ibid., sine loc. et alt. 4 Sep. 1850, *Hooker & Thompson* s. n. (K, CAL); Khasia, C. B. Clarke 21494 (K); Ibid., Vale of Rocks, alt. 1666 m., 21 Sept. 1886, *C. B. Clarke* 45454 (K, CAL); Jaintia hills, Jarin, alt. 1333 m., 20 nov. 1872, *C. B. Clarke* 18329 (K); S. Lushai, alt. 1333 m., Sept. 1931, *Wenger* 345 (K); Ibid., from Lungleh to 70 miles south, alt. 833-1333 m., July-Aug. 1931, *Wenger* 323 (K); Naga hills, Paona, alt. 2000 m., 2 Sept. 1935, *Bor* 6261 (K).

*Sonerila villosa* C. E. C. Fischer from Lushai hills closely matches *S. khasiana* C. B. Clarke in the nature of its habit, leaves, flowers and capsule. According to Fischer *S. villosa* differs from *S. khasiana* in having white villose pubescence in the stem, petiole, peduncle and pedicel and in having smaller flowers. In *S. khasiana*, it is seen, there are villose and glabrescent forms. Since there is variation in the size of flowers and since pubescence is not a stable taxonomic character in this taxon, it is proposed to reduce *S. villosa* C. E. C. Fischer to a synonym of *S. khasiana* C. B. Clarke.

This species is closely allied to *S. violaefolia* Hook. f. in the nature of its habit and leaves though *S. violaefolia* is a more robust species. Stapf (in Ann. Bot. 6:310, 1892) stated that the flowers and capsule of *S. violaefolia* are similar to those of *S. khasiana*. The capsule in *S. violaefolia* is obconic with thick wall, prominent ribs and conspicuous valves, whereas in *S. khasiana* the capsule is oblong or campanulate with thin wall, faint ribs and inconspicuous valves.

2. **Sonerila prostrata** Ridl. var. **johorensis** (Hend.) Nayar comb. et stat. nov. *Sonerila johorensis* Hend. in Gard. Bull. Straits Settlements 4:411, 1929. Type: *Holttum* 17500 (SING).

Henderson stated that this taxon is closely allied to *S. prostrata* Ridl., but differs in having larger leaves, anthers and petals. It is seen that in several taxa in the genus *Sonerila*, there is wide range of variation in the length of stamens. Stapf (in Ann. Bot. 6:291, 1892) established that the length of anthers could not be used safely as a character for the delimitation of species in *Sonerila*. Since there is variation in the size of leaves, it is proposed to reduce *S. johorensis* Hend. to a variety of *S. prostrata* Ridl.

3. **Sonerila matangenis** Ridley in Kew Bull. 1:35, 1946.

*Distribution:*

BORNEO: Sarawak, Mt. Matang, 14 Feb. 1892, *Haviland* 1049 (Type, K); *sine loc.*, *Ridley s. n.* (K).

In the original description, the number of stamens is mentioned as four. On dissecting the flowers, it is seen that there are only three stamens and the anthers are inappendiculate. It is presumed that Ridley's description of the number of stamens was based on an abnormal flower.

ACKNOWLEDGEMENTS

I wish to express my gratitude to Sir George Taylor, Director, Royal Botanic Gardens, Kew, for all facilities during my stay at Kew 1961-67. My thanks are also due to Rev. Fr. Dr. H. Santapau, Director, Botanical Survey of India for his encouragement.

INDUSTRIAL SECTION,
INDIAN MUSEUM,
BOTANICAL SURVEY OF INDIA, M. P. NAYAR
1, SUDDER STREET,
CALCUTTA-13,
*April* 30, 1968.

## 30. *ANTHRISCUS SCANDICINA* (WEBER) MANS. (APIACEAE): A NEW RECORD FOR INDIA

*Anthriscus scandicina* (Weber) Mans. a native of Europe, introduced and naturalized in North America (Mathias & Constance in N. Amer. Fl. 28B:115. 1944-45) is now recorded for the first time in India from Dehra Dun. A detailed description with presently accepted nomenclature and critical notes is given here.

**Anthriscus scandicina** (Weber) Mans. in Fedde, Report. 46:309. 1939. *Caucalis scandicina* Weber in Prim. Fl. Hol. 23. 1780. *Scandix anthriscus* Linn. Sp. Pl. 275. 1753. *Chaerophyllum anthriscus* (Linn.) Crantz, Class. Umbell. 76. 1767. *Anthriscus vulgaris* Pers. Syn. Pl. 1:320. 1805 (non Bernh. 1800). *Myrrhis anthriscus* (Linn.) Lag. Amen. Nat. 98. 1821. *Anthriscus scandix* (Scop.) Arch. Fl. Brand. 1:260. 1860. (non Bieb. 1808). *A. anthriscus* (Linn.) Karst. Deuts. Fl. 857. 1882. *Myrrhodes anthriscus* (Linn.) Kuntze, Rev. Gen. 1: 268. 1891. *Cerefolium vulgare* (Pers.) Bubani, Fl. Pyren. 2:411. 1900. *Chaerefolium anthriscus* (Linn.) Schinz. & Thell. Viert. Nat. Ges. Zurich 53:554. 1909.

Erect, much branched, foetid, more or less hispid, annual herbs, 8-15 (-30) cm. tall. Stems terete, striate. Leaves 3-4 pinnate,

basal ones long petioled, 6-10 cm. long (incl. petiole), upper ones reduced to sheaths, hispidly hairy; sheaths scarious-margined, ciliate; petioles hispidly hairy, grooved above, 1·5-4 cm. long; ultimate leaflets ovate-oblong, pinnatifid into ovate rounded, ciliate, mucronulate, hispid, of 0·15-0·2×0·1 cm. segments. Umbels compound, leaf-opposed, subsessile or width 0·06 (0·2) cm. long peduncles; rays 3-4 (-6), longer than the peduncles, glabrous, 0·3-1 (-2) cm. long. Involucral bracts 0 or rarely one linear-subulate, ciliate, 0·3-0·5 cm. long; involucels 4.5, entire, linear-lanceolate, acuminate, ciliate longer than the pedicels 0·18-0·2 (-0·25) cm. long. Flowers 3-5, white, pedicels glabrous, 0·1-0·3 (-0·8) cm. long; Calyx limb obscure. Petals 5, white, ovate-oblong, emarginate due to inflexed obtusely apiculate tip, 0·05 cm. long. Stamens 5, filaments linear, glabrous, 0·03-0·04 cm. long, anthers ovoid. Ovary hispid, styles 2, very short. Fruits ovoid-oblong, beaked, hispid with uncinate, bristly hairs or tubercles, 0·3 (-0·4) (incl. beak)×0·2-0·3 cm.; primary ridges obscure, secondary ones absent or obsolete.

Flowers & Fruits: April-June.

Specimens examined: UTTAR PRADESH: Dehra Dun. Kanpur (near Survey of India), *C. R. Babu* 35225 (BSD): Very rare, on waste places.

It is not possible to ascertain when and how this plant was introduced into India.

CENTRAL NATIONAL HERBARIUM,
BOTANICAL SURVEY OF INDIA,
HOWRAH,
*April* 25, 1968.

C. R. BABU

## 31. A NEW NAME IN *CAMPANULA* LINN. (CAMPANULACEAE)

**Campanula wallichii** nom. nov.

*C. canescens* Wall. (Cat. no. 1289, 1829, nom. nud.) ex Dc. Prodr. 7:473, 1838 (non Roth, 1827), Hook. f. & Thoms. in Journ. Linn. Soc. 2:23, 1857; Boiss. Fl. Orient. 3:934, 1875; Clarke in Fl. Brit. Ind. 3:439, 1881; Trimen, Handb. Fl. Ceylon 3:60, 1895; Duthie, Fl. Upp. Gang. Plain. 1:499, 1905; Gamble, Fl. Presid. Madras 739, 1921; Haines, Bot. Bih. & Oris. 4:503, 1922. *C. benthamii* Wall. (Cat. no. 1289, 1829, nom. nud.) ex DC. Prodr.

7:473, 1838 (pro syn.). *Cephalostigma spathulatum* Thwaites, Enum. Pl. Zeyl. 422, 1864 (non *Campanula spathulata* Sibth. & Sm. 1806).

Type: *Wallich* 1289 (CAL-isotype).

*Distribution:* India, Burma and Afghanistan.

The widely accepted binomial *Campanula canescens* Wall. ex DC. (1838) for this plant is unfortunately a later homonym of *C. canescens* Roth (1827) which is *Phyteuma canescens* (Roth) Walds. & Kitaib, and should be rejected according to Art. 64 of the International Code of Botanical Nomenclature (1966). The next name *C. benthamii* Wall. is also invalid, as it is a *nomen nudum*. The specific name *spathulatum* from *Cephalostigma spathulatum* Thwaites, is not available either for the present plant, as the specific name has already been used previously for three different plants in the genus *Campanula* Linn. Since there is no other published epithet for this plant, the author proposes the above new name, *C. wallichii*, for this interesting plant. The author's basis for the rejection of *C. canescens* Roth is the information given in the index Kewensis 401, 1895.

BOTANICAL SURVEY OF INDIA,
HOWRAH, C. R. BABU
*April* 25, 1968.

## 32 *GNETUM ULA* BRONGN. FROM RAYALASEEMA, ANDHRA PRADESH—A NEW RECORD

*Gnetum ula* Brongn. (*G. scandens* Brandis) was found growing abundantly, as a liana, reaching the tops of trees in the Savaralakuppadadi forest of Chittoor District during February 1968. The Savaralakuppadadi is a deciduous forest of Seshachalam hill range with patches of evergreen vegetation. Since *Gnetum ula* is recorded so far only from western and some parts of the eastern coast of India, its occurrence in Rayalaseema forms a new distribution for this interesting taxon.

The luxuriant growth of male and female plants with cones in different stages of development attracted attention from a distance at the time of collection. For a full description of this plant, see Bharadwaja (1957)

A number of male and female plants were collected and examined and it was found that this taxon is in conformity with that of *Gnetum ula* Brongn. of Bharadwaja (1957).

ACKNOWLEDGEMENTS

The authors thank Dr. I. M. Rao, Professor of Botany for encouragement and Dr. K. Subramanyam, Botanical Survey of India for going through the manuscript.

DEPARTMENT OF BOTANY,
S. V. UNIVERSITY,
TIRUPATI (A. P.),
*March* 25, 1968.

K. V. M. RAO
K. R. RAO

REFERENCE

BHARADWAJA, R. C. (1957): Genus *Gnetum* Linn. in India, Pakistan and Burma. *J. Indian bot. Soc.* **36**: 408-420.

# ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR 1967-68

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## HONORARY SECRETARY'S REPORT FOR THE YEAR 1967

### MEMBERSHIP

At the beginning of the year there were :

| | |
|---|---|
| Ordinary Members .. .. | 1,133 (746 paid) |
| Life Members .. .. | 254 |
| Forest Department Nominees.. .. | 75 |
| Student Members .. .. | 2 |
| Honorary Members .. .. | 2 |
| Total | 1,466 |

Since several of these members had delayed making payment we sent out letters to all Ordinary Members who were in arrears and to all Life Members to bring the records up-to-date. On the basis of information and payment received at the end of the year the Membership position is as follows :

| | |
|---|---|
| Subscription received from Ordinary Members for the current year | 567+53 for the previous year |
| Confirmed Life Members .. .. | 138 |
| Forest Department Nominees .. .. | 53 |
| Student Member .. .. . | 1 |
| Honorary Members .. .. .. | 2 |
| Total | 761 |

### THE SOCIETY'S JOURNAL

Four numbers of the *Journal* were published during the year, Vol. 63(2) and (3) and Vol. 64(1) and (2). The 860 pages include 9 articles on botany, 8 on birds, 7 on insects, 4 on fishes, 3 on mammals, 2 each on wild life and crustacea and 1 on other invertebrates. The 88 miscellaneous notes published in these numbers cover all aspects of Indian Natural History.

We have entered into an agreement with a firm in Sweden for microfiche reproduction of out-of-print issues of the *Journal.*

During the year the Society started a Newsletter HORNBILL with the object of keeping closer contact with members. The response from members has been satisfactory and with their assistance we hope to continue this effort.

### GENERAL

*Bird Migration Study :* During the year we received financial assistance from the Smithsonian Institution and the Migratory Animal Patho-

logical Survey of the U.S. Army. With this assistance it has been possible to enlarge our activities and to run camps continuously during the migratory season.

Camps at two locations were held during the year. A pilot survey camp in January at Chilka Lake (in association with the Genetics and Biometry Laboratory, Bhubaneswar, Orissa) ringed 887 birds of 33 species. The camp at Bharatpur commenced operations by mid-September and ringed over 13,000 birds by the end of the year.

During the year we received information on the recovery in Russia, Pakistan and India of 74 birds bearing our rings (4 species of ducks, 3 waders and 2 passerines).

*Additions to the collection :* During the year 662 specimens were received as additions :

| | |
|---|---|
| Mammals .. .. .. .. | 24 |
| Birds .. .. .. .. | 547 |
| Reptiles and Amphibians .. .. | 85 |
| Insects and other Invertebrates .. .. | 6 |

*Wild Life Preservation :* We are continuing with our efforts to preserve the forests around Bombay and to see that the Bird Sanctuary at Karnala is quickly brought into being. Our representatives on the Indian Board for Wild Life and the various State Wild Life Advisory Boards keep us informed about government policies and the Society continues to play a constructive rôle in these matters. Close contact is also being maintained with the International Union for Conservation of Nature and Natural Resources and World Wildlife Fund.

## PUBLICATIONS

The Society is now in the awkward position of not having financial resources to reprint its popular publications which have gone out of print. Applications made to several sources both governmental and non-governmental have not been effective. However, we have in press a revised 8th edition of the BOOK OF INDIAN BIRDS. This has been made possible by the generous assistance of Lady McNeice who has arranged for overdraft facilities to help the Society with this publication.

## DONATIONS

*Sálim Ali/Loke Ornithological Research Fund :* During the year we received donations from :

| | |
|---|---|
| Dr. Sálim Ali .. | Rs. 1,000.00 |
| Lady McNeice .. | Stg. £1,000 |
| Shri Asaf A. A. Fyzee .. | Rs. 100.00 |
| Lt. Col. H. Williams .. | Rs. 102.00 |
| Shri Duleep Matthai .. | Rs. 500.00 |

We thank them for the generous assistance. Letters were sent to members and others inviting donations to increase the corpus of the Fund.

*Furniture :* A donation of $100 was received from Mr. E. W. Mudge towards Chairs for the Auditorium.

## Research Studies

*Bhutan Bird Survey :* In February/April 1967, Dr. Sálim Ali accompanied by assistants from the Society surveyed the bird fauna of another area of Bhutan. A representative collection of Birds totalling 456 specimens was made. The collection will be reported on in a later issue of the *Journal.* The assistance rendered by Mr. J. D. Panday is gratefully acknowledged.

*Herpetological Survey :* Collections were made from various localities in the Nilgiris and some very interesting material was obtained.

*Birds and Agriculture :* The Council of Scientific and Industrial Research have approved the research project for assessing effect of birds in relation to Agriculture. We hope to commence work in 1968.

## Nature Education Scheme

The scheme is now in its 20th year and continues its activities in Poona and adjacent areas for creating interest in nature among school children.

## Library

During the year 76 books were added to the Library. Among these 25 were donated by the Haffkine Institute, Bombay. Other donations were 3 and 2 books were purchased and 46 received for review. Our thanks are due to the donors and to the publishers who have sent us review copies.

## Meetings

On 10 February, R. S. Dharmakumarsinhji spoke on 'Modern immobilisation techniques for wild life'; on 9 May a party was held in honour of Mrs. and Dr. S. D. Ripley; on 27 September Dr. E. B. Fanibunda spoke on 'Close-up photography of Nature subjects'; on 26 October Sir Landsborough Thompson spoke on 'A New Dic-

tionary of birds'; on 29 November under the joint auspices of Bombay S.P.C.A. & Bombay Natural History Society Mr. Zafar Futehally spoke on 'National Parks of America—some lessons for India'; on 13 December Lord Fermoy of the World Wildlife Fund spoke on 'Impressions of conservation programmes in Pakistan'.

## Exhibitions

Between 27 February and 4 March an exhibition of Bird paintings by Shri Deoki Nandan Sharma was held; on 18 March the Orchid Club of Bombay in association with the Bombay Natural History Society held an exhibition of flowering orchids; between 6 and 12 November an exhibition of 'Wildlife photographs' by Mr. M. Krishnan was held; between 11 and 17 December 1967 an exhibition of stamps by Mr. D. R. Mistry depicting butterflies was held.

## Revenue Account

The financial position of the Society continues to be difficult, and the all round increase in costs has put severe strain on even routine activities.

## Staff

The Committee wishes to record its appreciation of the willing co-operation of the entire staff in the activities of the Society.

## Acknowledgement

The Committee's thanks are due to Mr. J. L. Bernard who continues to look after the Society's interests in the United Kingdom.

Registered No. F. 244 (BOM)

# BOMBAY NATURAL HISTORY SOCIETY

THE BOMBAY PUBLIC TRUST ACT 1950

SCHEDULE VIII [VIDE RULE 17(1)]

## *BALANCE SHEET AS AT* 31 *DECEMBER* 1967

| FUNDS AND LIABILITIES | | Rs. P. | Rs. P. |
|---|---|---|---|
| *Trust Funds or Corpus :* | | | |
| *Life Membership Fund :* | | | |
| Balance as per last Balance Sheet .. | | 82,435·28 | |
| *Add :* Amount received during the year .. .. .. | | 3,279·00 | 85,714·28 |
| *Fixed Assets Fund :* | | | |
| Balance as per last Balance Sheet .. | | 37,010·49 | |
| *Add :* Grants and donations received during the year.. | 60,137·90 | | |
| ,, Transfer from Provision for Capital Losses .. | 3,338·16 | 63,476·06 | |
| | | 1,00,486·55 | |
| *Less :* Transferred to Income and Expenditure Account, on account of Depreciation .. .. | | 11,075·48 | 89,411·07 |
| *Provision for Capital Losses :* | | | |
| Balance as per last Balance Sheet .. | | 838·38 | |
| *Add :* Transferred from Income and Expenditure Account .. .. | | 3,338·16 | |
| | | 4,176·54 | |
| *Less :* Transferred to Fixed Assets Fund | | 3,338·16 | 838·38 |
| Carried forward .. | | | 1,75,963·73 |

| ASSETS | Rs. P. | Rs. P. |
|---|---|---|
| *Immovable Properties :* | | nil |
| *Motor Car :* | | |
| Balance as per last Balance Sheet .. | 6,344·71 | |
| *Add :* Additions during the year .. | 27,731·96 | |
| | 34,076·67 | |
| *Less :* Depreciation during the year .. | 2,193·23 | 31,883·44 |
| *Furniture, Fixtures and Equipment :* | | |
| Balance as per last Balance Sheet .. | 32,384·68 | |
| Additions during the year .. | 38,673·36 | |
| | 71,058·04 | |
| *Less :* Depreciation during the year .. | 8,882·25 | 62,175·79 |
| *Investments:* (At cost) | | |
| Rs. 11,000 4% Bombay Port Trust Bonds | 8,470·00 | |
| Rs. 5,000 4% Bombay Improvement Trust Bonds 1908 .. | 3,800·00 | |
| Rs. 25,000 3% Conversion Loan 1946/86 | 25,000·00 | |
| Rs. 2,000 3% 1st Development Loan 1970/75 .. | 1,948·75 | |
| Rs. 43,000 (Market value Rs. 30,994.50) | 39,218·75 | |
| Rs. 3,000 12 Year National Defence Certificates due 22-10-1975.. | | |
| Rs. 46,000 | 3,000·00 | |
| Carried forward .. | 42,218·75 | 94,059·23 |

*BALANCE SHEET AS AT* 31 *DECEMBER* 1967—*(continued)*

| FUNDS AND LIABILITIES | Rs. P. | Rs. P. |
|---|---|---|
| Brought forward .. | | 1,75,963·73 |
| *Building Fund*: | | |
| Balance as per last Balance Sheet .. | 27,070·76 | |
| *Less*: Transferred to Income & Expenditure Account, on account of Expenses on leasehold building | 7,470·00 | 19,600·76 |
| *Publication Fund*: | | |
| Balance as per last Balance Sheet .. | | 30,725·00 |
| *Other Earmarked Funds and Grants*: (As per Schedule A) .. | | 1,40,743·26 |
| *Liabilities* | | |
| For Expenses .. .. | 41,514·94 | |
| ,, Advance Subscriptions .. | 256·64 | |
| ,, Sundry Credit Balances .. | 1,250·39 | 43,021·97 |
| Carried forward .. | | 4,10,054·72 |

| ASSETS | Rs. P. | Rs. P. |
|---|---|---|
| Brought forward .. | | 94,059·23 |
| *Investments*: (At cost) (contd.) (Unquoted) | 42,218·75 | |
| *Less*: Provision for Depreciation .. | 6,750·00 | 35,468·75 |
| *Loans*: (Unsecured, considered good) | | |
| Loan Scholarship .. | Nil | |
| Other Loans (to staff) .. | 170·00 | 170·00 |
| *Advances*: (Considered good) .. | | |
| To Trustees .. | Nil | |
| ,, Employees (for camp expenses). | 1,433·32 | |
| ,, Others .. | 770·65 | 2,203·97 |
| *Stocks*: (At cost or under) | | |
| Books and publications .. | | 5,462·97 |
| *Income Outstanding*: | | |
| Rent .. .. .. | Nil | |
| Interest (Accrued) .. .. | 2,748·74 | |
| *Other Income:* | | |
| Supplies and Services .. .. | 30,598·06 | |
| Government of Maharashtra Education Activity Grant 1967-68 .. | 4,000·00 | |
| Government of Maharashtra Maintenance Grant 1967-68 .. | 34,160·00 | |
| Government of Maharashtra Building Maintenance Grant 1967-68 .. | 6,000·00 | |
| *Government of India* | | |
| Grant for Journal Expenses 1967-68. | 8,000·00 | |
| Grant for the publication of Handbook of Indian Birds 1967-68 .. | 9,000·00 | |
| *Grant from National Institute of Sciences*: | | |
| Grant for Journal Expenses 1967-68. | 1,000·00 | 95,506·80 |
| Carried forward .. | | 2,32,871·72 |

## *BALANCE SHEET AS AT* 31 *DECEMBER* 1967—(*continued*)

| FUNDS AND LIABILITIES | Rs. P. | Rs. P. | ASSETS | Rs. P. | Rs. P. |
|---|---|---|---|---|---|
| Brought forward .. | | 4,10,054·72 | Brought forward .. | | 2,32,871·72 |
| Notes.—<br>(1) There is a dispute pending on account of demands from the Society's Employees for extra Dearness Allowance in accordance with Government Rules. The amount is not ascertainable.<br>(2) Included in the Fixed Assets is a Jeep amounting to Rs. 27,731.96 which has been purchased out of the Grants from the Smithsonian Institution for Bird Migration Study Project.<br>(3) All expenses incurred on the various activities for which grants and donations are received have been directly debited to the relevant Fund Account.<br>(4) Annual subscriptions are accounted for on a cash basis. The amount due as at 31st December, 1967 from Members is not ascertainable. | | | *Cash and Bank Balances*:<br>(*a*) In Current Account with: | | |
| | | | National & Grindlays Bank Ltd., Bombay. .. | 13,646·42 | |
| | | | National & Grindlays Bank Ltd., London (£185-0-3) .. | 3,330·23 | |
| | | | Chartered Bank, Bombay .. | 34,993·78 | |
| | | | *In fixed Deposit with*: | | |
| | | | National & Grindlays Bank Ltd., Bombay .. .. .. | 60,000·00 | |
| | | | Bank of India Ltd., Bombay .. | 39,000·00 | |
| | | | (including Rs. 10,000 for Salim Ali/Loke Wan Tho Ornithological Research Fund and Rs. 3,000 for Col. Burton's Nature Conservation Fund) | | |
| | | | (The above Accounts are in the name of the Bombay Natural History Society) | | |
| | | | (*b*) With the Trustees .. .. | nil | |
| | | | (*c*) With the Cashier .. .. | 654·90 | |
| | | | *Income and Expenditure Account* | | 1,51,625·33 |
| | | | Balance as per last Balance Sheet .. | 25,881·05 | |
| | | | *Less*: Surplus as per Income and Expenditure Account .. .. | 323·38 | 25,557·67 |
| Total .. | | 4,10,054·72 | Total .. | .. | 4,10,054·72 |

The above Balance Sheet to the best of my belief contains a true account of the Funds and Liabilities and of the Property and Assets of the Trust.

(Sd.) J. D. Kapadia,
*Trustee*

As per our report of even date
(Sd.) A. F. Ferguson & Co.,
*Chartered Accountants*

Bombay, 24*th June*, 1968

Registered No. F. 244 (BOM)

# THE BOMBAY NATURAL HISTORY SOCIETY, BOMBAY-1

## THE BOMBAY PUBLIC TRUST ACT 1950

SCHEDULE IX [VIDE RULE 17(1)]

## *INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1967*

| EXPENDITURE | Rs. P. | Rs. P. |
|---|---|---|
| *To Expenses in respect of properties :* | | |
| Rates, Taxes, & Cesses .. | | nil |
| Repairs, and Maintenance .. | | nil |
| Salaries .. .. .. | | nil |
| Insurance .. .. .. | | nil |
| Depreciation (by way of provision or adjustments) .. .. | | nil |
| ,, *Expenditure from Grants from Government of Maharashtra :* | | |
| For 1966-67 : Salaries (Per Contra) .. | 9,107·51 | |
| For 1967-68 : Salaries (Per Contra) .. | 22,546·16 | |
| For 1966-67 : Building Maintenance (Per Contra) .. .. | 4,200·96 | |
| For 1967-68 : Building Maintenance (Per Contra) .. .. | 2,662·17 | |
| | | 38,516·80 |
| Carried forward .. | | 38,516·80 |

| INCOME | Rs. P. | Rs. P. |
|---|---|---|
| *By Rent :* | | |
| Accrued .. .. .. | nil | |
| Realized .. .. .. | nil | |
| ,, *Interest* (Accrued and Realized) | | nil |
| On Securities .. .. | 1,601·03 | |
| On Bank Account .. .. | 5,442·24 | |
| | | 7,043·27 |
| ,, *Dividends :* | | nil |
| ,, *Donations :* | | |
| In cash .. .. .. | nil | |
| In kind—One Film titled, 'Jungle Fowl of India and Ceylon' received from Dr. Collias of California not valued .. .. | nil | |
| ,, *Grants :* | | nil |
| *Government of Maharashtra :* | | |
| For 1966-67 (Expended as per contra) .. .. | 9,107·51 | |
| For 1966-67 (Expended as per contra) .. .. | 4,200·96 | |
| For 1967-68 (Expended as per contra) .. .. | 22,546·16 | |
| For 1967-68 (Expended as per contra) .. .. | 2,662·17 | |
| Educational Activity Grant 1967-68 .. | 4,000·00 | |
| Carried forward | 42,516·80 | 7,043·27 |

## INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1967—(*continued*)

| Expenditure | Rs. P. | Rs. P. |
|---|---|---|
| Brought forward .. | | 38,516·80 |
| *To Establishment Expenses :* | | |
| Salaries including Dearness Allowance | 41,138·75 | |
| Society's contribution to Staff Provident Fund .. .. | 2,853·58 | |
| Postages .. .. | 1,689·61 | |
| Printing and Stationery .. .. | ,402·30 | |
| Advertisements .. .. | 65·73 | |
| Telephone Charges .. .. | 704·05 | |
| Bank Charges .. .. | 279·57 | |
| Meeting Expenses .. .. | 653·00 | |
| Motor Car Charges .. .. | 674·20 | |
| Conveyance and Travelling .. | 143·01 | |
| Expenditure on Leasehold Building .. | 7,470·00 | |
| Rent .. .. | 1·00 | |
| | | 57,074·80 |
| *To Miscellaneous Expenses :* | | |
| General Charges .. .. | 1,401·75 | |
| Equipment Insurance and Field Staff Accident Insurance .. | 175·00 | |
| Repairs to Furniture .. .. | 34·00 | |
| Interest on Loan from Bank .. | 49·00 | |
| | | 1,659·75 |
| ,, Remuneration to Trustees .. | nil | |
| Remuneration (In the case of Math) | nil | |
| Legal Expenses .. .. | 300·00 | |
| Audit Fees .. .. | 810·00 | |
| Contribution and Fees .. .. | nil | |
| | | 1,110·00 |
| ,, *Amounts Written off :* | | |
| (*a*) Bad Debts .. .. | 230·94 | |
| Carried forward .. | 230·94 | 98,361·35 |

| Income | Rs. P. | Rs. P. |
|---|---|---|
| Brought forward .. | | 7,043·27 |
| *By Grants*: (contd.) | 42,516·80 | |
| *Government of India :* | | |
| For Journal Publication Expenses 1967-68 .. .. | 8,000·00 | |
| *National Institute of Sciences :* | | |
| For Journal Publication Expenses 1967-68 .. .. | 1,000·00 | 51,516·80 |
| ,, *Income from Other Sources :* | | |
| Membership Subscriptions .. | 25,290·91 | |
| Entrance Fees .. .. | 335·00 | 25,625·91 |
| ,, *Publications :* | | |
| Journal Sales .. .. | 5,641·53 | |
| ,, *Profit on sale of Books :* | | |
| Book of Indian Birds .. | 12,282·80 | |
| Some Beautiful Indian Trees .. | 51·72 | |
| Butterflies of the Indian Region .. | 1,944·14 | |
| A Syncpsis of the Birds of India and Pakistan .. .. | 550·00 | |
| Book of Indian Animals .. | 5,318·82 | |
| Indian Molluscs .. .. | 147·38 | |
| Identification of Poisonous snake charts .. .. | 173·00 | |
| Other Publications .. .. | 184·50 | |
| Nature Calendars .. .. | 3,9[illegible]0·46 | |
| Carried forward .. | 30,194·35 | 84,185·98 |

## INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1967—(*continued*)

| EXPENDITURE | Rs. P. | Rs. P. |
|---|---|---|
| Brought forward .. | | 98,361·35 |
| *Amounts Written off* (contd.) | 230·94 | |
| (*b*) Loan Scholarships .. .. | nil | |
| (*c*) Irrecoverable Rent .. .. | nil | |
| (*d*) Other Items .. .. | nil | |
| | | 230·94 |
| *To Depreciation :* | | |
| On Investment .. .. | nil | |
| On Furniture .. .. | 8,882·25 | |
| On Motor Car .. .. | 2,193·23 | |
| | | 11,075·48 |
| ,, *Expenditure on Objects of the Trust :* | | |
| (*a*) Religious .. .. | nil | |
| (*b*) Educational—Journal Expenses | 26,727·63 | |
| —Newsletter .. | 1,202·76 | |
| ,, *Library Account :* | | |
| Subscription to other Societies .. 1,098.94 | | |
| Purchase of Books .. 421.69 | | |
| Periodicals and Binding charges .. .. 470.45 | 1,991·08 | |
| ,, *Maintenance of Reference Collections* .. | 1,105·80 | 31,027·27 |
| ,, *Loss on exchange due to devaluation of £ Sterling* .. | | 298·50 |
| ,, *Surplus carried to Balance Sheet* .. | | 323·38 |
| Total .. | | 1,41,316·92 |

| INCOME | Rs. P. | Rs. P. |
|---|---|---|
| Brought forward .. | | 84,185·98 |
| *Profit on sale of Books* (contd ) | 30,194·35 | |
| *Less :* Loss on some Beautiful Climbers and Shrubs .. | 14·22 | |
| | 30,180·13 | |
| *Add* : Profit on packing and forwarding charges .. | 72·57 | |
| | | 30,252·70 |
| ,, *Miscellaneous Receipts* : (including 5% administrative charges on the expenses of various grants handled during the year and reimbursement of Salaries in field staff loaned for Bird Migration Study Camps) .. | | 8,332·76 |
| ,, Profit made on sale of Investments .. | 3,318·16 | |
| *Less* : Transferred to Provision for Capital losses .. | 3,318·16 | |
| | | nil |
| ,, Transfers : | | |
| From Fixed Assets Fund on account of Depreciation .. | | 11,075·48 |
| From Building Fund on account of expenses on Leasehold Building.. | | 7,470·00 |
| Total .. | | 1,41,316·92 |

As per our report of even date
(Sd.) A. F. FERGUSON & Co.,
*Chartered Accountants*

BOMBAY, 24th June, 1968

(Sd.) J. D. KAPADIA,
*Trustee*

# BOMBAY NATURAL HISTORY SOCIETY

## *SCHEDULE FORMING PART OF THE BALANCE SHEET AS AT* 31 *DECEMBER* 1967

| *Name of the Fund/Grant* (1) | *Balance as per last Balance Sheet* (2) | *Additions/ Amounts received during the year* (3) | *Transfers from other Funds* (4) | *Total of columns 2, 3, & 4* (5) | *Spent/ Refunded during the year* (6) | *Transfers to other Funds* (7) | *Total of columns 6 & 7* (8) | *Balance as at 31st December 1967 (minus) (5-8)* (9) |
|---|---|---|---|---|---|---|---|---|
| (1) Field Work Fund .. | 2,364·64 | .. | .. | 2,364·64 | 675·00 | .. | 675·00 | 1,689·64 |
| (2) Expedition Fund .. .. | 43·74 | .. | .. | 43·74 | 43·74 | .. | 43·74 | .. |
| (3) Mammal Survey Fund .. | 22·49 | .. | .. | 22·49 | 22·49 | .. | 22·49 | .. |
| (4) Staff Welfare Fund | 500·00 | .. | .. | 500·00 | .. | .. | .. | 500·00 |
| (5) Dr. Sálim Ali /Loke Wan Tho Ornithological Research Fund | 12,718·17 | 23,306·40 (including interest earned Rs. 665·00) | .. | 36,024·57 | .. | 949·97 (Survey of Bhutan Birds) | 949·97 | 35,074·60 |
| (6) Col. Burton's Nature Conservation Fund | 3,234·48 | 199·40 (Interest earned) | .. | 3,433·88 | .. | .. | .. | 3,433·88 |
| (7) Grant from California Academy of Sciences for Herpetological Survey | .. | 2,625·63 | .. | 2,625·63 | 411·02 | 11·69 (Refund of Advance 1966) | 422·71 | 2,202·92 |
| (8) Grant from Government of Bhutan for the Survey of Birds to Dr. Sálim Ali .. | 2,967·39 | 5,000·00 | 949·97 (Research Fund) | 8,917·36 | 8,917·36 | .. | 8,917·36 | .. |
| (9) Grant from Smithsonian Institution for the Secretarial Assistance to Dr. Sálim Ali on the Publication of Handbook of Indian Birds in Five Volumes .. .. | 23,289·65 | .. | .. | 23,289·65 | 11,716·74 | .. | 11,716·74 | 11,572·91 |
| (10) Grant from Seth Purushottamdas Thakurdas and Divaliba Charitable Trust for the Publication of Nature Study booklets for free distribution | 11,000·00 | .. | .. | 11,000·00 | 878·06 | .. | 878·06 | 10,121·94 |
| Carried forward .. | 56,140·56 | 31,131·43 | 949·97 | 88,221·96 | 22,664·41 | 961·66 | 23,626·07 | 64,595·89 |

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|
| Brought forward Rs. .. | 56,140·56 | 31,131·43 | 949·97 | 88,221·96 | 22,664·41 | 961·66 | 23,626·07 | 64,595·89 |
| (11) Grant from Smithsonian Institution for the Bird Migration Study Project .. | .. | 68,400·00 | .. | 68,400·00 | 46,943·78 | .. | 46,943·78 | 21,456·22 |
| (12) Grant from U.S. Government (Army) for Migratory Animal Pathological Survey .. | .. | 34,200·00 | .. | 34,200·00 | 122·69 | .. | 122·69 | 34,077·31 |
| (13) Grant from Government of India for the publication of Handbook of Indian Birds in five Volumes : | | | | | | | | |
| (*a*) 1965-66 Unspent .. | 13,723·32 | .. | .. | 13,723·32 | 13,723·32* | .. | 13,723·32 | .. |
| (*b*) 1967-68 .. | .. | 9,000·00 | .. | 9,000·00 | .. | .. | .. | 9,000·00 |
| (14) Grant from Government of India for the purchase of steel cabinets .. | 31,500·00 | .. | .. | 31,500·00 | 31,500·00 | .. | 31,500·00 | .. |
| (15) Grant from Government of India 1965-66 (Unspent) for the Survey of Birds at Nicobar .. | 6,157·74 | .. | .. | 6,157·74 | 6,157·74* | .. | 6,157·74 | .. |
| (16) Grant from Government of Maharashtra : | | | | | | | | |
| (*a*) Unspent grant of 1966-67 : | | | | | | | | |
| (*i*) For Establishment expenses .. | 9,387·42 | .. | .. | 9,387·42 | 9,107·51<br>279·91* | .. | 9,387·42 | .. |
| (*ii*) For Building Maintenance .. | 863·13 | .. | 3,337·83 (1966-67 Advance) | 4,200·96 | 4,200·96 | .. | 4,200·96 | .. |
| (*b*) Grant for the year 1967-68 : .. | | | | | | | | |
| (*i*) For Establishment expenses .. | .. | 34,160·00 | .. | 34,160·00 | 22,546·16 | .. | 22,546·16 | 11,613·84 |
| (*ii*) For Building Maintenance .. | .. | 6,000·00 | .. | 6,000·00 | 2,662·17 | 3,337·83 (Refund of Advance 1966-67) | 6,000·00 | .. |
| Total .. | 1,17,772·17 | 1,82,891·43 | 4,287·80 | 3,04,951·40 | 1,59,908·65 | 4,299·49 | 1,64,208.14 | 1,40,743·26 |

*The above amounts being unspent have been refunded to the relevant Government Authorities.

## BOMBAY NATURAL HISTORY SOCIETY

### *COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH GRANT-IN-AID*

*Receipts and Payments Account for the Year ended* 31 *December* 1967

| Receipts | Rs. P. | Payments | Rs. P. | Rs. P. |
|---|---|---|---|---|
| To Balance as at 1st January, 1967 brought forward : With National & Grindlays Bank Ltd., Bombay on Savings Account .. .. .. | 3,417·65 | By Refund of Grant-in-aid for 'The Role of Birds in our National Economy' to Council of Scientific and Industrial Research (Unspent) .. | | 1,506·67 |
| ,, Grant for Study of Sea-anemones of Maharashtra 1967-68 .. .. .. .. | 7,976·15 | ,, Grant for Study of Sea-anemones of Maharashtra 1967-68 : | | |
| | | Salaries .. .. .. | 6,000·00 | |
| | | Miscellaneous .. .. | 2,058·79 | 8,058·79 |
| ,, Grant for Study of the Ecology of Avian Species of importance to Indian Agricultural Economics 1967-68 .. .. .. .. | 3,550·00 | ,, Grant for Study of the Ecology of Avian Species of importance to Indian Agricultural Economics 1967-68 : | | |
| ,, Interest on Bank Account .. .. | 61·00 | Salaries .. .. .. | | 200·00 |
| | | ,, Balance as at 31st December, 1967 : On Savings Bank Account with National & Grindlays Bank Ltd., Bombay .. .. .. | | 5,239·34 |
| Total .. | 15,004·80 | Total .. | | 15,004·80 |

BOMBAY, 24*th June*, 1968

(Sd.) A. F. FERGUSON & Co.,
*Chartered Accountants.*

(Sd.) J. D. KAPADIA,
*Trustee.*

# BOMBAY NATURAL HISTORY SOCIETY

## *NATURE EDUCATION SCHEME*

*Receipts and Payments Account for the Year ended* 31 *December* 1967

| RECEIPTS | Rs. P. | Rs. P. | PAYMENTS | Rs. P. | Rs. P. |
|---|---|---|---|---|---|
| To Balances as at 1st January, 1967 brought forward : | | | By Salary of Nature Education Organiser | | 6,253·00 |
| Cash with Cashier .. .. | 49·55 | | ,, Printing and Stationery .. | | 570·43 |
| Balance with National & Grindlays Bank Ltd., Bombay on Current Account .. .. .. | 689·94 | | ,, Postages .. .. .. | | 204·71 |
| Credit balance with Bombay Natural History Society .. .. | 30·60 | | ,, General Charges .. .. | | 1,012·40 |
| | | 770·09 | ,, Refund of Unspent Grant from the Government of Maharashtra .. | | 149·05 |
| ,, Grant from Government of Maharashtra .. .. | | 7,640·00 | ,, Balance as at 31st December, 1967 :.. | | |
| ,, Sales of Nature Study Booklets .. | | 604·98 | Cash with Cashier .. .. | 50·00 | |
| | | | On Current Account with National & Grindlays Bank Ltd., Bombay | 743·91 | 793·91 |
| | | | ,, Balance from Bombay Natural History Society carried forward .. | | 31·57 |
| Total .. | | 9,015·07 | Total .. | | 9,015·07 |

BOMBAY, 24*th June*, 1968

(Sd.) A. F. FERGUSON & C.,
*Chartered Accountants.*

(Sd.) J. D. KAPADIA,
*Trustee.*

## MINUTES OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY HELD AT HORNBILL HOUSE, SHAHID BHAGAT SINGH ROAD, BOMBAY 1, ON FRIDAY, 19TH JULY 1968, AT 6.15 P.M., WITH DR. SÁLIM ALI, D.SC., F.N.I., IN THE CHAIR

(1) The Honorary Secretary's report for the year ending 31st December, 1967, having been previously circulated to members, was taken as read and was adopted.

(2) The Balance Sheet and Statement of Accounts presented by the Honorary Treasurer were approved.

(3) The following were elected as members of the Executive and Advisory Committees for the year 1968-69:

### EXECUTIVE COMMITTEE

*President*

Dr. P. V. Cherian, *Governor of Maharashtra*

*Vice-Presidents*

Major-General Sir Sahib Singh Sokhey, I.M.S. (Retd.)
Dr. Sálim Ali, D.SC., F.N.I.
Rev. Fr. H. Santapau, S.J.

*Hon. Secretary*

Mr. Zafar Futehally

*Hon. Treasurer*

Mr. J. D. Kapadia, I.C.S. (Retd.)

*Member*

Secretary, Ministry of Education, Govt. of India

*ex-officio*

*Elected Members*

Mr. Humayun Abdulali
Mr. G. V. Bedekar, I.C.S. (Retd.)
Prof. P. V. Bole
Mr. S. Chaudhuri
Mr. R. E. Hawkins
Dr. C. V. Kulkarni
Mr. Duleep Matthai
Dr. A. N. D. Nanavati, M.D.
Mr. D. J. Panday
Mr. D. E. Reuben, I.C.S. (Retd.)

ADVISORY COMMITTEE

| | |
|---|---|
| Mr. H. G. Acharya .. .. .. | *Ahmedabad* |
| Mrs. Jamal Ara .. .. .. .. | *Ranchi* |
| Mr. F. C. Badhwar, O.B.E. .. .. .. | *New Delhi* |
| Sir Chintaman Deshmukh, Kt., C.I.E., I.C.S. (Retd.).. | *New Delhi* |
| Mr. E. P. Gee, M.A., C.M.Z.S... .. .. | *Shillong* |
| Mr. M. Krishnan .. .. .. | *Madras* |
| Dr. N. K. Panikkar, M.A., D.SC., F.N.I. .. .. | *New Delhi* |
| Dr. Baini Prashad, D.SC., F.N.I. .. .. | *Dehra Dun* |
| Mr. P. D. Stracey, I.F.S. .. .. .. | *New Delhi* |
| Lt. Gen. Sir H. Williams, C.B., C.B.E., M.I.C.E., M.I.E. | *New Delhi* |

(4) Films received from the British High Commission at Bombay, were shown.

(5) The meeting terminated with a vote of thanks to the British High Commission, for the films and to the Chairman of the meeting.

PRINTED AND PUBLISHED BY C. E. KOSHY AT THE DIOCESAN PRESS,
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EDITORS: H. SANTAPAU, ZAFAR FUTEHALLY & J. C. DANIEL

# THE SOCIETY'S PUBLICATIONS

## Mammals

**The Book of Indian Animals,** by S. H. Prater. 2nd (revised) edition. 28 plates in colour by Paul Barruel and many other illustrations. **Rs. 30**

(*Price to members Rs.* 25)

## Birds

**The Book of Indian Birds,** by Sálim Ali. 8th (revised) edition. 66 coloured and many monochrome plates. **Rs. 25**

(*Price to members Rs.* 20)

## Snakes

**Identification of Poisonous Snakes.** Wall chart in English, Gujarati, and Marathi. **Rs. 10**

(*Price to members Rs.* 8)

## Miscellaneous

**Butterflies of the Indian Region,** by M. A. Wynter-Blyth. With 27 coloured and 45 monochrome plates. **Rs. 28**

(*Price to members Rs.* 22.50)

**Indian Molluscs,** by James Hornell. With a coloured and many monochrome plates, and text-figures. **Rs. 6**

(*Price to members Rs.* 4.50)

**Picture Postcards of 12 representative Indian Birds** (In colour) per set **Rs. 2·50**

**Glimpses of Nature Series** Booklets :

1. OUR BIRDS I (with 8 coloured plates) in Hindi, and Marathi. **Rs. 0·80**
   Kannada **Rs. 0·62**
2. OUR BIRDS II (with 8 coloured plates) in Hindi. **Rs. 0·62**
3. OUR BEAUTIFUL TREES (with 8 coloured plates) in Hindi, and Marathi **Rs. 0·62**
4. OUR MONSOON PLANTS (with 8 coloured plates) in English, Gujarati, Hindi, and Marathi **Rs. 0·80**
5. OUR ANIMALS (with 8 coloured plates) in English, Gujarati, Hindi, and Marathi. **Rs. 1·25**

**Back numbers of the Society's Journal.** Rates on application.

*Correspond with :*
**The Honorary Secretary,**
**Bombay Natural History Society,**
**Hornbill House, Shahid Bhagat Singh Road, Bombay 1-BR.**

*Agents in England :*
**Messrs Wheldon & Wesley Ltd.,**
**Lytton Lodge, Codicote, Near Hitchin,**
**Herts, England.**

The Society will gratefully accept back numbers of the *Journal,* particularly numbers prior to Vol. 45, from members who may not wish to preserve them.

## TERMS OF MEMBERSHIP

**Life Members** pay an entrance fee of Rs. 5 (5*sh.*) and a life membership fee of Rs. 600. (Inland), £45-10-0 (Foreign).

**Ordinary Members** pay an entrance fee of Rs. 5 (5*sh.*) and an annual subscription of Rs. 36. (Inland), £3 (Foreign).

Members residing outside India should pay their subscription by means of orders on their Bankers to pay the amount of the subscription to the Society in Bombay on the 1st January in each year. If this cannot be done, then the sum of £3-0-0 should be paid annually to the Society's London Bankers—The National & Grindlays Bank Ltd., 26 Bishopsgate Street, London E.C. 2.

The subscription of members elected in October, November, and December covers the period from the date of their election to the end of the following year.

## CONTENTS